GRADUATE CATALOG 2022-2023

Policies, Procedures, Academic Programs

GRADUATE SCHOOL POLICIES & PROCEDURES

Student Life and Related University Policies

University Policies for Student Life

All students enrolled at Virginia Tech are subject to student life policies set by the university. The university publication, University Policies for Student Life is available at https://codeofconduct.vt.edu/. This document is applicable to students matriculated at the Blacksburg campus, as well as those students at branch campuses, higher education centers, or other university owned or leased properties. In addition, information about medical and health related policies and parking are included below.

Physical Examination

All Blacksburg campus students, admitted to the university for the first time, must complete a physical examination form and return it to Student Health Services http://www.healthcenter.vt.edu/

Medical Insurance Coverage

The university has contracted with an insurance carrier to offer group coverage for all students at Virginia Tech. For details on levels of coverage and specific limitation, please contact the Student Medical Insurance office in the Student Services Building, 540/231-6226 or 231-6303, or visit https://risk.controller.vt.edu/studentmedicalinsurance.html. Medical insurance is mandatory for all international students with F-1 or J-1 visa status and their accompanying dependents in F-2/J-2 visa status. Insurance requirements are posted at https://risk.controller.vt.edu/studentmedicalinsurance/international-students-.html. Medical insurance is mandatory for all College of Veterinary Medicine students at a minimum of $100,000 accident and sickness coverage. All students in these two areas must show in writing that they have coverage from another insurance company that is equal to or better than the minimum levels required by the university, or they must purchase the university-sponsored student plan. Review of insurance policies is done by the Student Medical Insurance office https://risk.controller.vt.edu/studentmedicalinsurance.html.

Required Insurance for Students Traveling Internationally

Virginia Tech's Global Travel Policy (Policy No. 1070) stipulates that all Virginia Tech faculty, staff, and documented representatives traveling internationally for business purposes enroll in an appropriate university-approved Global Travel Insurance program, regardless of any alternative coverage they might have. This requirement extends to students participating in university-supported global education experiences (for credit or not for credit), who are required to carry international emergency medical and assistance services insurance. The approved Global Travel Insurance provider currently is Cultural Insurance Services International (CISI). The CISI plan provides emergency medical coverage and evacuation, security evacuation, and repatriation services. This coverage is provided on a per-person fee basis. The cost for CISI coverage is an allowable international travel expense for university travelers. On Call International – A benefit of the Aetna Student Health Insurance planStudents on the Student Health Insurance Plan through Aetna, which is offered to full-time students attending the university, have access to On Call International. For questions regarding On Call International, please contact the Student Medical Insurance Office at (540) 231-6226 or email to SMI@vt.edu. Students who are not enrolled in the VT student insurance plan may purchase the university-approved CISI plan through the Office of Risk Management, phone: (540) 231-7439. Students should purchase optional coverage prior to leaving the U.S.A. For the link to the CISI application or if more information is needed, please visit the Risk Management website.

Automobiles and Bicycles

Motor vehicles owned and operated by students who drive them on campus and bicycles must be registered with the University Parking Services Office when the vehicle is brought on campus. Parking information and regulations are available at https://parking.vt.edu

Graduate Application and Admission

Admission to the Graduate School is contingent upon receipt of a four year (or 3 year degree recognized by the Bologna process) bachelor's degree from a regionally accredited college or university and the presentation of evidence of potential to pursue graduate work. Additional requirements for graduate degrees, beyond those of the Graduate School, vary across academic units. Prior to submitting an application, individuals are encouraged to review the requirements and conditions for admission. Degrees and their requirements, as well as information about which degrees are offered at non-Blacksburg sites, are available at: https://secure.graduateschool.vt.edu/graduate_catalog/programs.htm. Students currently enrolled for graduate degrees at other universities are usually expected to complete their degree requirements prior to their matriculation at Virginia Tech. Applications for admission are reviewed and evaluated by the departmental Graduate Admissions Committee. Major factors considered in this evaluation are scholastic record, professional experience, letters of recommendation, and as appropriate, scores on standardized tests. Individual departments may have additional admission standards beyond those set by the Graduate School. Applications and all related materials for admission should reach the Graduate School Office at least eight weeks before the beginning of the semester in which enrollment is requested. For financial assistance information, visit http://www.finaid.vt.edu. Applications for admission should be submitted on-line at:https://graduateschool.vt.edu/admissions/how-to-apply.html. If this is not possible, a printable application also is available.

Credentials

Applicants should submit copies of their transcripts with the online application. Unofficial copies are acceptable for review by the department and Graduate School. Upon admission, official transcripts should be sent to the Virginia Tech Graduate School. If the official transcript submitted for admission does not show bachelor's degree completion, the applicant will need to later supply another official transcript showing that the degree has been awarded/conferred. Letters of reference can be submitted on line (preferred) or sent directly to the academic department. Individual departments may require applicants to submit the results of the Graduate Record Examination (GRE). For applicants to the Pamplin College of Business, the Graduate Management Admissions Test (GMAT) is required. Please request that GRE or GMAT scores, if applicable, be sent to Virginia Tech. The Educational Testing Service Institution Code for Virginia Tech is 005859. Please visit academic department websites for other departmental requirements such as resumes, vitas, portfolios, etc. All credentials submitted in support of an application become the property of the university.

International Applicants

Legal Status and Financial Certification All international students must hold valid non-immigrant visa status to enroll at Virginia Tech. Prior to the issuance of a certificate of eligibility to apply for the appropriate visa (I-20 or DS-2019 form), all international students must submit documentation of funding and demographic information. The following link provides information about what and how to submit: https://international.vt.edu/Immigration-Services/new-students.html. The Cranwell International Center will collect (1) information required for issuance of visa eligibility documents and (2) information that demonstrates that a student has sufficient financial resources for at least the first year of education. International students in F-1 and J-1 visa status and their accompanying dependents are required to carry health and accident insurance approved by Virginia Tech. International students who have been admitted and have shown proof of having sufficient funds to cover their educational and living expenses for at least one year are issued visa eligibility documents (I-20 or DS-2019 forms) by the Cranwell International Center. Evidence of English Proficiency International applicants are exempt from demonstrating English proficiency if they have graduated from an accredited university where English is the language of instruction or if they are U.S. permanent residents ("green card" holders). International applicants may demonstrate English proficiency by submitting scores from the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). A minimum TOEFL score of 577 on the paper-based test (PBT) or 90 on the internet-based test (iBT) is required for consideration of the application. On the iBT, subscores of at least 20 on each subtest (Listening, Speaking, Reading, and Writing) are required for admission. A minimum IELTS score of 6.5 is required for admission. Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School. Students who anticipate appointment as Graduate Teaching Assistants are expected to have scored 25 or greater on the TOEFL Speaking subtest. GTA appointment of a student scoring 20-24 on the Speaking subtest should be justified explicitly within the particular academic unit; appointment of a student scoring below 20 on the Speaking subtest requires justification with the Graduate School. For more details, see http://graduateschool.vt.edu/admissions/how-to-apply/testing-requirements.html. Attending at Extended-Campus Locations International students in F-1 or J-1 visa status may pursue graduate degrees in Blacksburg or at the extended-campus in the National Capital Region (NCR). Questions regarding enrollment eligibility at the NCR location should be directed to the International Graduate Student Services office of the Graduate School in NCR at 703/538-3743, GSSONCR@vt.edu; http://www.ncr.vt.edu/. Requirements for Assistantships and Employment International students in F-1 or J-1 status who obtained admission into a degree program are eligible for consideration by the academic departments for assistantships and in-state tuition scholarships. Part-time employment on campus is subject to federal regulations governing employment of student (F-1) and exchange visitor (J-1) visa holders. Blacksburg students should contact the Cranwell International Center, international@vt.edu, 540-231-6527; National Capital Region students should contact 703/538-3743, GSSONCR@vt.edu.

Admission Categories and Graduate Student Classifications

Students are admitted or classified in one of the following categories:

Regular Admission

Regular Admission to a graduate degree is open to an applicant whose grade point average (GPA) meets or exceeds the 3.00 required by the Graduate School for the last half of the credits earned for the undergraduate (bachelors) degree, and whose academic background meets the requirements of the admitting academic unit. A graduate degree, or at least 12 credits of graduate coursework taken post-baccalaureate, while in graduate status, will supersede the undergraduate record in evaluating credentials for admission.

Provisional Admission (Master's only)

Provisional Admission to a graduate degree is open to an applicant whose GPA is below the 3.00 required by the Graduate School, but generally not lower than 2.75, who has other experience or qualifications that demonstrate potential to undertake graduate study, and whose admission is requested by the admitting academic unit. Provisionally admitted students are regular degree-seeking students with the condition that they must earn at least a 3.00 GPA for the first 12 graduate credits they attempt. If a 3.00 GPA is not earned in the first 12 credit hours attempted, the Graduate School will consult with the academic unit to determine whether the student should be allowed to continue for one additional semester on probationary status (see Academic Progress, Probation). Appropriate coursework taken while on Provisional status may be included on the Plan of Study for the student's graduate degree at the discretion of the student's Advisory Committee.

Conditional Admission

An applicant whose academic background is deficient in some aspect, but who otherwise meets minimum GPA qualifications for admission (Regular or Provisional) may be granted “conditional” admission. The admitting academic unit specifies and informs the conditions of admission to the applicant and the Graduate School by letter prior to applicant matriculation. The academic unit notifies the Graduate School when the conditions have been met.

Non-degree Status

Non-degree status is open to an applicant who qualifies for admission to the Graduate School in Regular status (i.e., who has a 3.00 GPA or better for the last 60 credit hours of undergraduate study) but who does not wish to, or cannot be, listed as a degree candidate for one of the following reasons: (a) does not currently desire to work toward a graduate degree; (b) desires to transfer the credits for use toward a graduate degree at another institution; or (c) there currently is no higher degree available at the university other than the one the applicant currently holds in the department or field of study. Official transcripts of the undergraduate degree are required for admission to this status. The university places no limits on the total number of credits that may be taken while in Non-degree status. Credits earned by students in Non-degree status may be used in meeting degree requirements, if they are appropriate for inclusion, in the Plan of Study if the student is later admitted to a graduate degree. Graduate students in Non-degree status are not eligible for graduate assistantships. International Exchange Students in J1 status only may hold Non-degree status for up to two semesters (note that TOEFL score requirements do apply).

Commonwealth Campus Status

Commonwealth Campus status is open to an applicant who holds an earned bachelors or higher degree from a regionally accredited U.S. university. Examples of students who seek admission into the Commonwealth Campus program include those who (a) may qualify for regular admission but do not currently wish to work for a graduate degree; (b) do not qualify for admission because of a poor undergraduate record and wish to improve their credentials; (c) need to update their academic credentials after several years of professional experience or (d) require graduate courses for professional certification. International students in F1 or J1 visa status are not eligible for Commonwealth Campus status. However, some other types of visa status may allow non-degree enrollment (note that TOEFL or IELTS score requirements do apply). Students applying for Commonwealth Campus status must complete the Application for Admission and submit a transcript (unofficial is sufficient) or a copy of their diploma for the highest degree attained. Students in Commonwealth Campus status are not eligible for graduate assistantships. Commonwealth Campus students are limited to 12 credits of course work while in this status. Students may not earn a graduate degree while enrolled in Commonwealth Campus status. If a Commonwealth Campus student wishes to enter a degree program, the Application for Admission to that degree needs to be filed early in the semester prior to the desired semester for degree entry. If the student is accepted to a degree, a determination of the applicability of any courses taken while in Commonwealth Campus status, to a graduate degree, will be made at the time of submission of the Plan of Study for the degree.

Graduate Certificate Status

A qualified student who wishes to enter Virginia Tech to obtain a graduate certificate, without being enrolled in a degree program, may apply for graduate admission to Graduate Certificate status. Such applicants should submit concurrently an Application for Admission and a Graduate Certificate Application 1. https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Application_for_Graduate_Certificate_Program.pdf. The Graduate School requires a GPA of 3.0 for admission to Certificate Status and official transcripts must be submitted. Note that students pursuing a degree and a certificate simultaneously are classified in their degree program. All credits applied to the earning of a graduate certificate may be used in meeting degree requirements if they are appropriate for inclusion on the Plan of Study for the degree. No credits can be triple-counted.

Visiting Graduate Student Status

A graduate student in good standing at another university may be permitted to take graduate courses by submitting a Visiting Graduate Student Application form, available at https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Visiting_Graduate_Student_Application.pdf. Enrollment as a visiting graduate student is limited to one calendar year or 18 credit hours.

Eligibility of Faculty/Staff for Graduate Degrees

Teaching and research faculty of the rank of assistant professor or above shall not become candidates for degree or be awarded graduate degrees from this university. The Provost's Office may be requested to waive this policy for an individual following successful appeal to the Commission on Faculty Affairs. Staff and administrative/professional faculty may become candidates for graduate degrees with approval from the academic program, the university employer, and the graduate school. To receive approval, candidates must address conflicts of interest, time, and commitment. Supervisors of these candidates should abstain from chairing and/or serving on the candidates' graduate committees to avoid potential conflicts of interest. The Conflict of Interest Agreement form and guidelines for staff and administrative/professional faculty seeking a graduate degree may be downloaded at https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Employee-student_COI_agreement_May2023.docx. Questions may be directed to Associate Dean Bill Huckle (wrhuckle@vt.edu). Once completed, the form may be uploaded to: https://docs.google.com/forms/d/e/1FAIpQLSfjrNXTmzLlagnZBctWkEAmYA8b7aRmmRlJmAp1l70G6Bo2SQ/viewform

Undergraduates Taking Graduate Courses

Seniors Students in their senior year, with a 3.0 or better GPA, may enroll in 5000-level courses satisfying undergraduate degree requirements within their department with the permission of the course instructor and the Department Head. Should the student become a graduate student, these courses may not be used on the Plan of Study for a graduate degree. Dual Student Status Seniors in a bachelor's degree, who have a GPA of 3.0 or better may be eligible for Dual Status during the final semester of their undergraduate degree. To obtain this status, students must file an application for the master's degree and the Accelerated Undergraduate/Graduate Degree and Course Designation Request (for obtaining Dual Status) (https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Accelerated_UG-GR_Degree_and_Course_Designation_Request.pdf). The department reviews the student for master's acceptance and, if this is recommended, indicates on the Admission Analysis form that the student will be accepted for Dual Status for the final semester of the undergraduate degree. This acceptance must occur prior to the final semester of the undergraduate degree. Graduate coursework taken during the semester of dual registration may only be designated for use in the graduate degree when it is not used to meet bachelor's degree requirements (i.e., each course taken during the final semester is specified as being for either the bachelor's or the master's degree). A grade of B or higher must be earned in each Dual course to be placed on the graduate transcript. Combined Student Status (Architecture Only) This status is reserved for qualified students in the bachelor of architecture program who: (a) are within 24 semester hours of graduation; (b) are proceeding toward the two-year master's program in architecture; and (c) have at least a 3.0 GPA for the last two years (60 credit hours) of undergraduate studies. Combined students are permitted to take graduate courses. Accelerated Undergraduate/Graduate Degree Programs In accordance with the policy of the Commission on Graduate and Professional Studies and Policies for accelerated undergraduate/graduate degree programs, "each graduate degree program wishing to offer one or more accelerated undergraduate/graduate degree programs must submit a written description of their program to the Graduate School for review and approval before students may be admitted hereto." Consistent with Graduate School policy, the standards for each program must meet the minimum requirements but can exceed these (e.g., GPA, fewer courses to be double counted). These regulations include the following: Students must be accepted into the program prior to the beginning of the semester in which they would enroll in courses to be used on the accelerated program. Students qualifying for the program must be in the last 12 months of their undergraduate degree. A minimum GPA of 3.3 is required at the time of acceptance to the program Once completion of the undergraduate degree has been verified, students accepted into this accelerated program will be classified as regular graduate students. A maximum of 12 credits of graded coursework may be used in the program. No more than 6 of the double-counted credits may be at the 4000 level; all others must be offered for graduate credit. A grade of B or higher must be earned in each course to be double counted. Courses must not be taken pass-fail if a graded option is available. Programs that intend to accept students into an accelerated graduate program must submit a proposal to the Graduate School that includes the following: Accelerated program(s) to be offered. These can include programs designed for VT students as well as non-VT students from U.S. institutions or in partnership with international institutions. Graduate degrees included - master's or doctoral degrees, or both. Admission criteria and application materials required, including but not necessarily limited to student status, minimum GPA requirement, statement of motivation and career objectives, student's experience and qualifications as reflected in a resume, a portfolio, and/or letters of reference. The number of credits to be double counted towards undergraduate and graduate degrees. Process for identifying potential students and faculty advisors, and for mentoring during program. Tentative listing of courses that the department expects to be used for graduate plans of study for students in the program. Other conditions or aspects of the proposed program as appropriate.

Enrollment and Registration Procedures

Course Enrollment and Changes in Enrollment

Registration Registration (Course Request; for continuing students occurs during an eight-day period in the middle of each semester during which current students may request and be registered electronically for classes for the next semester. Registration for new students begins prior to the start of the new semester. For registration procedures, see http://www.registrar.vt.edu/. Schedule Adjustment Students may adjust their schedules on a space available basis using web DROP/ADD (available through HokieSPA http://www.hokiespa.vt.edu), an electronic schedule adjustment program. The Add Period is restricted to a short period at the beginning the semester, the Drop Period lasts for a larger proportion of the semester; deadlines for these electronic transactions that can be done by the student are published in the Timetable of Classes for each semester, see Important Dates and Registration Information at: https://banweb.banner.vt.edu/ssb/prod/HZSKVTSC.P_DispRequest. Force-Add A Force-Add form permits enrollment in a class, over the set capacity for that class, within the Add period. This transaction is done with the "force-add" form in the department offering the course, and requires the instructor's (or, in some departments, departmental) permission. Force-adds are processed by the department offering the course during the Add Period in the first week of classes of each semester. Late Adds and Drops Late Adds and Drops: In unusual circumstances when adjustments to the student's schedule are needed after the last date to add or drop a course, permission is required from the instructor, the student's advisor and a graduate dean (see the current Timetable for deadline dates). The request for the Late Add or Drop and an explanation of the extenuating circumstances necessitating the late change should be submitted to the Dean's office by the student's Advisor or the Graduate Program Director of the department. Graduate Withdrawal Course withdrawals late in the semester: If a late withdrawal from a course (after the Drop period for electronic drops) is approved it will be designated as a Graduate Withdrawal (WG on the transcript) and will not carry a grade penalty; this option is only allowed prior to the Friday of the last week of classes for the semester. Use this form: https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Course_Withdrawal_Request.pdf If a student wants to Withdraw from all courses for the semester or if a student who is enrolled for a single course wants to drop that course, a Resignation/Withdrawal form (see below) must be submitted to the Graduate School for approval and to the Registrar's office by specific deadlines.
Resignation/Withdrawal A student may resign/withdraw without academic or tuition penalty by completing an official Virginia Tech Resignation/Withdrawal form on or before the first day of the semester/summer session (for relevant dates, see the Registrar's Office website: https://www.registrar.vt.edu/resignation-withdrawal.html). The Student Withdrawal/Resignation Form is available at http://registrar.vt.edu/content/dam/registrar_vt_edu/documents/Updates/forms/Student-Withdrawal-Resignation-Form.pdf.
Resignation/withdrawals received at the Registrar's office after 5 pm on the first day of the semester result in partial tuition and fee charges (see Bursar's office refund policy https://www.bursar.vt.edu/students/refunds.html.
Resignation/withdrawal after the specified date for withdrawing without grade penalty requires permission of a Graduate Dean and is only permitted because of extenuating circumstances. The student's grade report and transcript will show that he/she was enrolled for the term and that he/she resigned on the specific effective date.
Resignation/withdrawals may have consequences for assistantship and scholarship awards as well as visa status, so these considerations should be investigated prior to completing the forms.
Resignation/withdrawals do not affect the student's ability to enroll in the subsequent semester. The Graduate School (VP/Dean and Associate Deans) reviews and approves the appropriate date of the withdrawal. For medical withdrawal with official Schiffert review, the date recommended by Schiffert or Cook is accepted. For withdrawal or resignation from the university (all courses in a given semester, consideration is given to the length of time the student was enrolled in the course and utilized university (faculty, staff) time and resources, the date the form was submitted and the percentage of refund allowed by the Registrar's office, and the reasons for withdrawal. Decisions by the Graduate School can include a retroactive withdrawal or adjustments to the specified deadlines for refund. Student responsibility for enrollment Student responsibility for enrollment. Each student is responsible for verifying his/her enrollment in courses and for making any changes in that enrollment. Students should check their enrollment in specific courses during the first week of classes of a semester (the Add Period) when any corrections can be made electronically. Faculty cannot add or drop students from their rolls and cannot add or drop a student by including or removing his/her name on the final grade sheet.

Continuous Enrollment

Unless on approved in absentia or leave of absence status, graduate students in degree programs must be registered continuously at VT during the academic year (fall and spring semesters) and pay the prescribed tuition and fees (See Policy PPM 291). Students working on research/scholarly activity toward their thesis or dissertation should enroll in the number of credit hours that reflects the extent of a student's study or research activity. The minimum enrollment is for 3 credit hours at VT except in the case of a student who qualifies for Start of Semester Defense Exception. If the student holds a Graduate Assistantship, scholarship, or other form of financial support, the enrollment requirement is typically set by the conditions for that support. Students on Graduate Assistantships must be enrolled for a minimum of 12 credits per semester (see Academic Eligibility to Hold a Graduate Assistantship). Individual graduate programs may seek approval from the Graduate School to temporarily or permanently exempt some or all of their students from this policy. Such exemptions may be granted to programs that are dominated by distance learning, to programs that are specifically directed at part-time students, to salaried employees qualifying under Policy 4800, or for other appropriate reasons. Graduate students who need to break continuous enrollment can do so by applying for a leave of absence or by participating in programs and activities approved by the Graduate School that require absence from the University (in absentia status). Students who fail to follow this process will be resigned from the university by the Graduate School, and will then need to apply for readmission in order to continue their studies. Readmission requires a positive recommendation from each student's home academic unit, and is not guaranteed.

Leave of Absence

Students sometimes experience situations in which they cannot be continuously enrolled (e.g., health, family emergency, change in parental status, military service, financial hardship, personal or academic reasons, or other reasons). A student may request a leave of absence to suspend activities associated with course work or thesis/dissertation research (see Policy PPM 292). Students on leave of absence are not entitled to use University resources not normally available to the public or alumni (e.g., may not consult with advisors or work on courses or research). The Leave of Absence Request Form must be submitted two weeks before the beginning of the semester for which the leave is requested. The leave of absence must be approved by the student's advisor and the Department Head or Graduate Program Director for the department before submission to the Graduate School. If the leave of absence request is approved, the continuous enrollment requirement will be relaxed during the period of leave. The Leave of Absence form indicates when the student will return to the program and any conditions the department or the Graduate School may stipulate for the student's readmission within that time. Leaves of absence may be granted for up to one year at a time. If a leave longer than one year is required, students will need to apply to the Graduate School for readmission. International students should consult an immigration advisor in the Cranwell International Center or in the Washington DC Metro Area before requesting a leave of absence.

Registration at the Time of Examinations and for Degree Completion

Graduate students must be registered at VT for at least the minimum number of credits (3 credit hours) in the semester or summer session when they take an examination required by Graduate School Policies and in the semester when a degree is completed (see Continuous Enrollment). Students who have a thesis/dissertation ready for defense by the beginning of a semester, may schedule that defense early in the semester and qualify for Start of Semester Defense Exception (SSDE, 1 credit); see Start of Semester Defense Exception under Examinations and see Dates for Degree Completion at: http://graduateschool.vt.edu/academics/what-you-need-to-graduate/deadlines-for-academic-progress.html. Students are not required to be enrolled for the purpose of certificate completion alone.

Readmission

When a student has not been registered for more than one calendar year, an Application for Readmission http://graduateschool.vt.edu/admissions/how-to-apply/readmission.html is required whether or not the student has been on a formal Leave of Absence. The Readmission process requires a review of the student's progress and of the Plan of Study to determine what changes, justification of old course work, committee changes or other conditions may be required for readmission to the degree (the forms required for these processes are at: http://graduateschool.vt.edu/academics/what-you-need-to-graduate/forms.html The minimum enrollment is 3 credits.

Changes of Status

A change from one type of degree status to another, while remaining in the same major, requires a Change of Degree Level Request form https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Change_of_Degree_Level_Request.pdf . An example of a status change is: Master's to Ph.D. in the same major. International students in F1 or J1 status should consult with the international advisors in the Graduate School for the proper SEVIS changes. For departments where the non-thesis option is available, a master's degree candidate is allowed to change status from the thesis to the non-thesis option (or vice versa) only once. The Thesis Option Change Request form https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Thesis_Option_Change_Request.pdf requires accompanying documentation from the department that verifies the appropriateness of the change of status. A change from Commonwealth Campus or Non-degree status to Master's or Ph.D. requires an Application for Admission and submission of official transcripts (if these weren't previously submitted) and all other required application materials (https://graduateschool.vt.edu/admissions/how-to-apply.html)

Change of Graduate Program

Change of Graduate Program (between departments) A change from a degree in one graduate program/department to a degree in another program/department requires the approval of the Graduate Program Director or Department Head of both the old and the new programs and the Graduate School. https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Change_of_Graduate_Program_Request.pdf Students wishing to change programs should consult with the department they wish to enter to determine the likelihood of acceptance prior to beginning this process. The department the student wishes to enter may see the original application materials by making a request to the Graduate School and may request additional materials from the student.

Change of Campus

Students who wish to study at a different campus, but remain in the same major, should submit a Change of Campus form https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Change_of_Campus_Request.pdf. International students in F1 or J1 status should consult with their international advisors in the Cranwell International Center or Greater Washington DC Metro area as appropriate.

Simultaneous Graduate Degrees

Students wishing to work toward two graduate degrees in different departments/programs should submit an Application for Simultaneous Graduate Degree form. See also Credit Hour Requirements; Simultaneous Degrees.

In Absentia Status

Graduate students in good standing who for academic reasons need to spend an entire Fall or Spring semester away from campus can apply for and be granted in absentia status (see Policy PPM 293). In absentia status is granted for work that is directly related to a student's academic course of study and that is integral to her or his degree. Examples include field research, clinical internship, or laboratory work with research collaborators at remote institutions. In absentia status is approved by each student's home academic unit and then by the Graduate School. During each Fall or Spring semester in absentia, students must register for one credit hour. To qualify for in absentia status, students must be stationed a minimum of 50 miles away from Blacksburg, and must not work on or in conjunction with any of Virginia Tech's satellite campuses and facilities. Students can remain in absentia for two consecutive semesters, but must then return to residency at the University for a minimum of one semester. Exemptions may be granted by the Graduate School when longer periods of absence are required. In absentia status is not available to students who have not adhered to the continuous enrollment requirement, are supported by an assistantship, or are participating in an exchange program or dual degree program with an officially designated partner institution.

Graduate Cooperative Education Program

See Presidential Policy Memorandum 27 at http://www.policies.vt.edu/policymemos/PPM27.pdf All students are expected to be making reasonable academic progress towards a degree while participating in a Graduate Cooperative Education Program. The responsibility for monitoring students' academic progress is shared by their department and the Graduate School. Someone in the Graduate School shall be appointed to represent the University in matters related to the Graduate Cooperative Education Program. This person shall sign all graduate co-op agreements between the participating firm and the University. [Note: Contact an immigration advisor at the Graduate School.] The department or degree conferring unit shall be the prime unit in negotiating all graduate co-op agreements. The rights and needs of the University will be protected in all agreements by review of the agreement by the University's representative. All graduate cooperative programs must be approved by the department or degree conferring unit. As consistent with these specifications, departmental policies with regard to registration, course load, course number, course credit, program of study, and advising will remain the province of the cooperating department. Nothing will be included in the agreement that will intrude upon the privileged relation between the faculty advisor/major professor and his/her student. All students involved in graduate cooperative programs shall be enrolled in the one-credit course "Graduate Cooperative Education Program," GRAD 5944 (master's students) or GRAD 7944 (doctoral students), and pay the appropriate fee while on co-op assignments. See additional details at https://graduateschool.vt.edu/student-services/GradCoop.html.

General Academic Information

Grading System

Assignment of grades is the responsibility of the course instructor. The university has adopted the following grading system: Letter Grade Numerical Value (GPA) A 4.0 A- 3.7 B+ 3.3 B 3.0 B- 2.7 C+ 2.3 C 2.0 C- 1.7 D+ 1.3 D 1.0 D- 0.7 F 0.0 Grades in all courses, assigned one of the letter grades above, are calculated into the overall GPA on the transcript. An additional GPA is calculated for the Plan of Study for each graduate degree. There are, in addition to the above grades, the following grades that do not calculate into the GPA: "I" (Incomplete), "P" (Pass; performance of C- or higher when enrolled for the P/F grade option), "X" (a temporary grade for the first semester in those courses that continue across more than one semester; "EQ" (Equivalent Credit, a "pass" for research or project/report credit); "RG and RP" (Repeat Graduate grades) and "NR" (grade Not Recorded, indicating the instructor did not enter a grade). The "NG" (No Grade, assigned when the student has not done any of the work for the course) and the grade "F" on a course taken Pass/Fail calculate as 0.0 in computing the GPA.

Grade for Thesis/Dissertation/Major Paper

Research toward a thesis, dissertation or major paper (the last is generally designated as Project and Report credits) is assigned equivalent credit hours (EQ grade) when satisfactory progress has been made. The "NG" grade can be given when progress on a thesis or dissertation has not been satisfactory.

Incomplete, X, NG and NR Grades

An Incomplete ("I") grade, which is not calculated in the GPA, may be given when the requirements of a course have not been completed because of illness or extenuating circumstances. It is at the discretion of the instructor whether the circumstances warrant the assignment of an Incomplete. Incompletes should be removed, by completing the course requirements, as soon as possible. Departments should set policies for the time allowed for removal of "I" grades and the number of "I" grades that are allowed by students in their programs. Grades of "I" may be removed during a period when the student is not enrolled at the university. Grades of "X" are assigned initially to students in a course that extends over more than one semester and are removed when the final grade for the course is entered. Graduate degrees cannot be completed until all "I", "X", "NG" and "NR" grades on the Plan of Study have been converted to a passing letter grade (i.e., a C- or better for courses with the A/F grading option, a P for courses only offered on the P/F grading option). If a student is ready to complete a graduate degree and grades of “I”, “X”, “NG” or “NR” are present on the transcript but off the Plan of Study, the department should investigate why these grades have not been remedied. In many cases these grades reflect unresolved problems or errors that can and should be remedied. However, as long as the student has a GPA of 3.0 or better both on the Plan of Study and overall, these grades can remain on the transcript and not interfere with degree completion.

Grading System Requirements

All courses taken at Virginia Tech that are included on the Plan of Study, i.e., courses that satisfy degree requirements, must be taken for a letter grade (A/F) except for those courses offered on a pass/fail (P/F) basis only (for example, Independent Study courses and most seminars are only offered P/F). Courses on the Plan of Study with grades below "C-" must be repeated. Courses on the Plan of Study, once taken, cannot be removed from the Plan of Study. Graduate students are permitted to take additional courses on a pass/fail basis only if those courses are not on their Plan of Study, are outside the department, and are approved by the student’s advisor. Such courses may not be used to satisfy minimum degree requirements. Under the graduate P/F grading option, a "P" is granted for earning a "C-" or better in a course. Once credit is received for a course taken P/F, the course may not be repeated under the A/F grading system.

Repeating Courses

Courses originally taken on the P/F option, in which a grade of "F" is earned, may only be repeated on a P/F basis. Courses may not be repeated if a "P" grade is earned, or without permission of the Graduate School if a grade of "C-" or better is earned. When a course is repeated the grade for the earlier enrollment will be a Repeat Graduate ("RG", defined as a grade of "C-" or lower; "RP", defined as a grade of "C" or higher, when the course was first taken) which will not calculate into the GPA. Only the grade earned for the final enrollment in the course will receive a letter grade and be calculated in the GPA. If a student wishes to repeat a course in which the first grade earned was a C- or higher, permission for a policy exception must be obtained from the Dean's office prior to taking the course a second time.

Auditing

An audit requires approval of the instructor. Auditing of laboratory work is not permitted. Registration for Audit may not be changed to credit, or vice versa, after the last day to add classes without an exception to policy by the instructor, the student's major advisor, and the Dean of the Graduate School. If the student or the instructor expects evaluation of coursework, then the student must enroll either as a P/F option or for a letter grade. If a faculty member wishes to require the participation of auditing students in selected activities, then that should be stated in the syllabus or communicated to the student. Students are assessed the same rate of tuition and fees for audited courses as for courses taken for credit. Audited courses do not count toward full-time enrollment.

Graduate Credit

Students must have a recognized status with the Graduate School (i.e., have been admitted to graduate studies) and be officially enrolled in a course to earn graduate credit in that course. Graduate courses at Virginia Tech are numbered 5000 or higher. As of Fall 2009 there are no 4000-graduate approved courses (see information about the limited use of undergraduate courses on Plans of Study). Instructors should not allow students to attend if they are not enrolled in a course (i.e., are not on the official Class List, which can be viewed on HokieSpa in Faculty Access, by the end of the Add Period for the semester). Students should resolve all enrollment problems before the end of the Add Period to be able to obtain credit for a course.

On-line Courses/Independent Study in Absentia/Continuing Education

On-line courses offered for graduate credit from accredited universities may be considered for transfer credit (see section on transfer credit limitations in Plan of Study). Independent study (5974) or Graduate Research credits (5994 or 7994) completed while the student is residing at a distance from the instructor's Virginia Tech location must have regular faculty consultation by means such as email or regular telephone calls. No credit toward graduate degrees may be obtained by correspondence study or from continuing education courses.

Academic Progress

GPA Requirements

Students must obtain a 3.00 GPA, both overall and for courses on the Plan of Study. All courses on the approved plan, including supporting courses must be completed with a grade of "C-" or better (see Graduate Degree and Certificate Requirements section below).

Scholarly Ethics and Integrity

The student's progress on completing the four required scholarly ethics and integrity topics plus additional topics relevant to the discipline must be reported in the annual review. Details of approved plans and requirements for all graduate programs are listed on the Scholarly Ethics and Integrity website at the following link:
https://graduateschool.vt.edu/academics/programs/ethics-requirement.html.

Probation due to Unsatisfactory Grades

Students whose cumulative GPA falls below a "B" (3.00 GPA) will be placed on probation by the Graduate School. Enrollment for one semester of probation normally is permitted to remedy an unsatisfactory GPA. If the student does not achieve a 3.0 GPA within one semester after being placed on probation, the Graduate School will consult with the department about dismissal of the student from Graduate School. A department can appeal to the Graduate School for additional time for the student to achieve a 3.0 GPA, providing the student is making reasonable progress in raising the GPA. If an appeal is made to the Graduate School for additional time it should come from the departmental Graduate Program Director or the Department Head. If extra time is granted, the student should be informed in writing of the amount of additional time allowed for achieving a 3.0 GPA. If the department does not support a time extension, the student will be dismissed from the Graduate School.

Satisfactory Progress toward a Graduate Degree

All graduate students are required to have an Annual Review of Progress at least once a year by their Advisory Committees. Students who do not yet have a Plan of Study and an Advisory Committee should be reviewed by the Graduate Program Director or a departmental Graduate Committee. If a student fails to make satisfactory progress toward degree requirements (coursework, grades, research, projects, examinations, and other requirements), permission may be denied to continue in the degree program. This decision may be reached by the student's Advisory Committee, a graduate program Evaluation Committee in the department and the Graduate Program Director, or the Department Head, and recommended to the Graduate School. The Graduate School will dismiss the student for unsatisfactory progress following the recommendation by the department. The departmental recommendation should include documentation of at least one review indicating unsatisfactory progress, communication to the student about what was needed to reestablish satisfactory progress, and evidence that the student's progress continued to be unsatisfactory (second review).

Inclusion and Diversity Training

The student's progress on completing the Inclusion and Diversity training approved for their graduate program should be be reported in their annual review of academic progress. Details of approved plans and requirements for all graduate programs are listed on the Inclusion and Diversity Requirement website at the following link:
https://graduateschool.vt.edu/academics/programs/inclusion-diversity-req.html.

Enrollment Limits and Requirements

Full Time Enrollment

Full-time enrollment for graduate students, for purposes of tuition and fees, consists of a minimum of 9 credit hours during academic year semesters. However, the Commonwealth of Virginia does not count students as full time unless they are enrolled for at least 12 credits, and in most academic contexts, 12 credits is considered full time. The maximum number of credit hours is 18 during academic year semesters. Overloads (19 credit hours or more per semester) require permission from a graduate dean.

Graduate Student Employment/Assistantships

Graduate Assistants (GAs, GTAs, and GRAs) must enroll for at least 12 credit hours per semester to be eligible for their assistantship. Students on full assistantship are expected to work an average of 20 work hours per week for the assistantship and are considered to be 50% employed. Graduate students on assistantship can enroll for up to 18 credit hours of course work in academic year semesters and up to 6 credit hours during each summer session.

Virginia Tech Employees

Tuition Waivers or Reimbursement: Full-time salaried employees, who have been admitted to the Graduate School (see the section below on Eligibility of Faculty/Staff for Graduate Degrees), and with the approval of their department, may have waived or reimbursed twelve (12) credit hours per calendar year (Fall through Summer II), not to exceed six (6) credits in a Fall, Spring, Summer I, or Summer II term. Part-time salaried employees are eligible for up to 6 credit hours of tuition waiver per academic year. The maximum number of credit hours will include tuition waiver, tuition reimbursement, or a combination of both. For more information, refer to the Human Resources' website: http://www.hr.vt.edu/benefits/tuhttp://www.hr.vt.edu/benefits/hokie-perks/continuing-education.html

Fellowship and Scholarship Recipients

Fellowship and scholarship recipients are required to take at least 12 credit hours each semester in which they are receiving a stipend. These credit hours must represent work toward satisfying minimum degree requirements. Audited courses do not qualify in satisfying this minimum.

Graduate Assistantships

Types of Assistantships

There are three types of graduate assistantships: Graduate Assistant (GA): GAs provide academic and program support to faculty or departments. GA responsibilities may be administrative in nature and consist of duties unrelated directly to teaching or research (such as academic advising, program planning, advising student groups, and assisting with the administration of student services offices). GA responsibilities also may be academic in nature and include grading examinations, problem sets, and/or lab assignments, setting up displays for lectures or laboratory sections, and preparing or maintaining equipment used in laboratory sections. Graduate Teaching Assistant (GTA): GTAs assist faculty in the department in the teaching mission, with assignments including laboratory teaching, grading of examinations, problem sets and/or lab assignments, setting up displays for lectures and laboratory sections, and preparing or maintaining equipment used in laboratory sections. GTAs must have 18 credit hours of graduate-level course work in their teaching discipline to be assigned full responsibility for teaching an undergraduate course. GTAs lacking this training may be assigned to work under the supervision of a faculty member who will be the instructor of record for the course. Graduate students may assist faculty in teaching graduate courses but may not be the instructor of record for the course. GTAs are required to attend and be enrolled in the GTA Workshop (GRAD 5004, 1 cr., P/F) in the first fall semester of their teaching appointment at Virginia Tech. Other students who hope to qualify for a GTA appointment in the future should take the workshop in their first semester at Virginia Tech. The workshop consists of Phase I (two half days, Monday and Tuesday of the week before classes start in August) a wide variety of Phase II sessions during fall semester. Graduate Research Assistant (GRA): GRAs conduct research under the direction of a faculty member, who is typically a principal investigator on an external grant or contract that funds the GRA and determines the nature of research work required for the assistantship. The research work required for the GRA is determined by the funding source and is typically beyond research done for academic credit toward the student's degree.

Academic Eligibility to Hold a Graduate Assistantship

Assistantships may be offered to degree seeking graduate students admitted to Regular (GPA of 3.0 or greater) or Provisional (GPA of 2.75-2.99) status. To continue to be eligible for an assistantship a student must maintain a GPA of 3.0 or higher and be making satisfactory progress toward attainment of a graduate degree. The academic department and the Graduate School may allow a student to continue on an assistantship for one semester of probationary status to remedy grade deficiencies. Students on assistantships must be enrolled for a minimum of 12 credit hours per academic year semester. Audited courses do not qualify in satisfying this minimum. Graduate students holding assistantships during the academic year and/or in the summer are not required to enroll during summer sessions, except if they are taking a preliminary or final examination.

Additional Employment for Students Holding a Graduate Assistantship

Unless specified otherwise in the assistantship agreement contract, graduate students on full assistantships are not prohibited from seeking additional employment. Students should consult with their academic advisor and/or assistantship supervisor as applicable regarding the fulfillment of their assistantship and graduate study responsibilities. Students must notify the Graduate School about any additional employment agreement, including the period of employment, name and contact of employer, and job title or short description of duties https://secure.graduateschool.vt.edu/aert/logon.htm.

Graduate Degree and Certificate Requirements

General Degree Requirements for Graduate Students

For a graduate student, the university degree requirements are those identified in the Graduate Catalog (Policies and Procedures) effective for the academic year in which the student files the Plan of Study. If the requirements will change in the coming academic year (cases where the governance system has set new policy to be effective at the beginning of the next academic year), the graduate student may choose, but is not required, to abide by the "new" requirements. For graduate students not enrolled for more than one calendar year, requirements will be reviewed on a case-by-case basis at the time of Readmission.

Plan of Study

Submission and Approval Submission and Approval. All graduate students must submit a Plan of Study that meets at least the minimum Graduate School requirements for the designated degree. The Plan of Study must be approved by the student’s Advisor and Advisory Committee, the Graduate Program Director or Department Head, and the Graduate School. All courses on the Plan of Study, including supporting courses, must be taken on a letter grade (A/F) basis except for those courses approved to be graded on a pass-fail (P/F) basis only. Audit courses cannot be included on the Plan of Study. After approval by the student's Advisory Committee and the Graduate Program Director or Department Head, the Plan of Study should be entered and sent electronically to the Graduate School for approval, according to the following schedule. Master’s Master’s: The Plan of Study is due by the end of the second academic semester for all Master's degree students (based on full time enrollment of 12 credits per semester). For the Master of Architecture or Master of Urban and Regional Planning degrees, the Plan of Study is due before 30 credit hours are completed. For Bachelors/Masters students, the Plan of Study is due by the end of the first full semester of graduate study. Ph.D. Ph.D.: The Plan of Study is due by the end of the third academic semester for all doctoral students (based on full time enrollment). Ed.D. Ed.D.: The Plan of Study is due no later than 30 days after the successful completion of the required qualifying examination. The qualifying exam is an Ed.D. requirement, not a Graduate School requirement. Transfer Courses on the Plan of Study Transfer Courses on the Plan of Study. No more than 50% of the graded credit hours needed to satisfy the requirements for a Virginia Tech graduate degree may be transferred in from a regionally accredited university. All such credits must have earned grades of "B" or better, have been earned while in good standing in graduate status, and must have been graduate courses (numbered 5000 or higher) at the institution where the student took the courses. Grades of "S" or "P" are not acceptable for transfer credit. All transfer courses must be acceptable to the student’s Advisory Committee and the Graduate Program Director or Department Head. For transfer course work more than five years old, a Justification of 'Old' Course Work form must be filed with the Plan of Study (see below). Credits from other universities are transferred to a Virginia Tech graduate degree at the time the Plan of Study that includes those courses is approved by the Graduate School. Transferred courses count only as credit hours and are not included in the calculation of the Virginia Tech GPA. Official transcripts are required before transfer course work can be approved for the Plan of Study. Research, Project and Report, Practicum or Internship credit hours may not be transferred in from another university to meet Virginia Tech graduate degree requirements (i.e., they cannot be included on the Plan of Study). Credits taken while in undergraduate status or for an undergraduate degree cannot be used as transfer credit for a graduate degree.

Justification of ’Old’ Course Work

Justification of ’Old’ Course Work. Academic work, including transfer credit more than five years old at the time the Plan of Study is submitted, requires Justification for inclusion on the plan. The Justification form requires an Advisory Committee explanation of how the committee will insure that the student will update their knowledge for out-of-date courses. The Course Justification Request form is at https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Course_Justification_Request.pdf and some procedural guidelines are at http://graduateschool.vt.edu/academics/graduate-catalog-policies-procedures/justification_of_old_coursework.html Justifications remain valid throughout the degree unless the student is out of enrollment for a period exceeding one calendar year. Justification of “old” course work and review of the Plan of Study occurs at the time of re-admission.

Supporting Courses

Supporting Courses. Supporting courses are those the student's Advisory Committee considers necessary to provide missing background for taking the key courses required for the student's degree program. Courses numbered lower than 4000 can only be used on the Plan of Study as Supporting Courses. All courses listed on the Plan of Study, including Supporting Courses are requirements for the degree and must be completed with a grade of "C-" or better. However, supporting courses do not count toward the minimum number of credit hours required for the degree.

Plan of Study Changes

Plan of Study Changes. A Plan of Study Change Form https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Plan_of_Study_Change_Request.pdf is necessary whenever changes are made to the course work on the Plan of Study. Changes to the Plan of Study must be approved by the student's Advisory Committee, the Department Head or Graduate Program Director and the Graduate School. Once a course on the Plan of Study has been taken for a grade, it must remain on the Plan of Study.

Change of Thesis Option

Change of Thesis Option. A master's degree candidate is allowed to change from the thesis to the non-thesis option (or vice versa) only once. These changes require approval of the Department Head/Graduate Program Director and the Chair of the student's Advisory Committee. Use this form: https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Thesis_Option_Change_Request.pdf . Such changes often require changes in the coursework and Plan of Study.

Grades on Plan of Study Courses

Grades on Plan of Study Courses. All graded courses on the Plan of Study must be taken for a letter grade (A/F) except for those courses offered on a pass/fail (P/F) basis only (for example, Independent Study courses and many seminars are only P/F). Students must maintain a 3.0 GPA or better on the Plan of Study course work. Once a course on the Plan of Study is taken for a grade, it must remain on the Plan of Study.

Repeating Courses on the Plan of Study

Repeating Courses on the Plan of Study. Students are required to repeat any courses on the Plan of Study in which a grade below "C-" has been earned. Courses may not be repeated if a "P" grade is earned or without permission of the Graduate School if a grade of "C-" or better is earned. After a course has been repeated, the grade for the first enrollment will be Repeat Graduate (RG, defined as a "C-" or lower; RP, defined as a grade of "C" or higher when the course was first taken). Only the most recent enrollment in the course will receive a letter grade and be calculated in the GPA.

Graduate Advisory Committees

Committee Functions The student's Advisory Committee works with the student to design a Plan of Study, approves the Plan of Study, provides advice, conducts required examinations and regularly assesses the student's progress and accomplishments. Advisory Committee members are appointed by the Graduate School on recommendation of the Department Head or Graduate Program Director via submission of a Plan of Study listing the proposed committee Chair ("Major Advisor") and committee members. Although all members of the Advisory Committee have a role in guiding the student’s program, the Chair of the student’s committee is solely responsible for assuring that supervision of the student’s program is conducted in accordance with the expectations and policies of the university, the Graduate School, and the program’s academic home. For this reason, only Virginia Tech faculty members are eligible to serve as an Advisory Committee Chair. In some cases, it may be desirable to appoint a committee Co-Chair, in recognition of that member’s disciplinary expertise or a existing scholarly relationship with the committee Chair; however, there remains but a single Chair (not two Co-Chairs) with authority to direct the student’s program of study. Examples of committee members for whom a role of Co-Chair may be justified include faculty members from institutions outside of Virginia Tech who maintain an ongoing research collaboration or jointly-funded project with Virginia Tech faculty members who would chair the committees in question. Committee Composition and Size Advisory Committees will be composed principally of Virginia Tech-employed Graduate Program faculty members, who have the primary responsibility for the operation and integrity of graduate education programs in their departments, schools, and programs (“academic units”). These individuals are recommended by their academic units to serve as Graduate Program faculty members on the basis of having earned the appropriate terminal degree (or having gained equivalent professional experience), maintaining a record of scholarly productivity, and showing evidence of successful involvement with graduate education within the previous five years. Virginia Tech faculty members who meet the three criteria above can serve as Chairs, Co-Chairs, or Members of graduate student advisory committees. Eligible faculty categories include the Tenured/Tenure-track, Clinical, Extension, Collegiate, Research, and Professor of Practice ranks as defined in the Virginia Tech Faculty Handbook. Virginia Tech faculty members who meet the first two criteria but have not previously had the opportunity to advise or supervise graduate students can, if paired with or mentored by an experienced Virginia Tech faculty member, qualify as Graduate Program faculty and can serve as Chair, Co-Chair, or Member on graduate student Advisory Committees. Department Heads/Chairs or Graduate Program Directors may nominate faculty members in their academic units for Graduate Program Faculty status by submitting the form at https://docs.google.com/forms/d/e/1FAIpQLSdmnzEYr6e48l2kspRNp-j76l_7q9N5KQmgs-sRJNlc7ZNfXw/viewform?edit_requested=true. You must be logged into your VT Google account to access this Google form. A downloadable guide to completing the online request form can be found here.) A student pursuing a Master's degree must have an Advisory Committee composed of at least three members with qualifications described above, e.g., the appropriate terminal degree (Master's degree or higher). In some instances, it is appropriate to have fewer (minimum of 1) faculty members serving on the Advisory Committee when students are pursuing a coursework-only degree (e.g., MBA). Departments offering coursework-only degrees can petition the Commission on Graduate and Professional Studies and Policies for approval to reduce the size of the committee. Doctoral candidates must have an Advisory Committee of at least four members with the qualifications described above. The student should also refer to the departmental policies and procedures document for any guidelines for graduate advisory committee service or composition specific to their department or program. In addition to members of the Graduate Program faculty, other individuals can be appointed to serve as Members or as Co-Chairs under certain circumstances as noted under Committee Functions above, on graduate student Advisory Committees. This category includes retired or Emeritus Virginia Tech faculty members, Virginia Tech employees (e.g., Research Scientists, Administrative/Professional Faculty, Instructors), and non-Virginia Tech-employed individuals including Adjunct Faculty, who are qualified by terminal degree/professional experience and scholarly productivity and who, by inclusion, can provide specific expertise to enrich the student's program. Recommendation that such an individual be appointed to serve on a graduate student's Advisory Committee is made by the student's home academic unit using the form linked above and approved by the Graduate School. Identification of Committee Members Selection of an individual student's Advisory Committee membership, drawn from the Virginia Tech Graduate Program faculty and, if desired, approved non-Graduate Program faculty individuals, is performed jointly by the student and their Major Advisor and approved by the Graduate Program Director of the student's home academic unit when the student's Plan of Study is prepared. Graduate Program faculty members must constitute at least two-thirds of the minimum committee membership (e.g., at least two of the three members for master's degrees and at least three of the four members for doctoral degrees). Once the minimum committee membership total has been satisfied as described, individuals not meeting the criteria of degree/experience credentials, scholarly achievement, and graduate education experience may be added as additional Members of a student's committee if, in the view of the student's home academic unit, that individual can provide specific expertise to enrich the student's program. Approval of these individuals for service is likewise recommended via the form identified above. In selecting members of their Advisory Committees, students and their committee Chairs should take pains to avoid situations that might create conflicts of interest for the student or be impacted by coercive relationships among the committee members or between the student and committee members. It is of paramount importance that all committee members be free to evaluate the student's work based on its academic merit alone. Composition of the student's Advisory Committee is communicated by the Graduate Program Director to the Graduate School in the form of the student's Plan of Study, on which all committee members are signatories. Additional considerations Faculty members are not permitted to serve as Advisor or committee member for family members (spouse or dependent immediate family member), nor for individuals with whom they have a close personal relationship, such as partner or extended family member, or a close professional relationship such as business associate or supervisor. A faculty member with a significant financial interest in a company may not serve as Chair of an Advisory Committee for either a student funded through a university-sponsored project supported by the faculty member's company or a student employed directly by the faculty member's company. The faculty member with the conflict may serve as Co-Chair or committee member. If another Chair is appointed, that faculty member must be of equal or greater rank, must have no involvement with the sponsoring company, and must not be subject to undue influence by the faculty-owner. See Policy 13010 for a complete description of the disclosures and protections required in such instances. Graduate students (including those Virginia Tech employees who are pursuing graduate degrees) may not serve on a graduate Advisory and/or Examining Committees. Post-doctoral scholars or other advanced degree holders who have earned their graduate degrees at Virginia Tech will not be approved for service on Advisory Committees of students with whom they overlapped as students. See also Eligibility of Faculty/Staff for Graduate Degrees (https://secure.graduateschool.vt.edu/graduate_catalog/policies.htm?policy=002d14432c654287012c6542e3720084) for a description of steps needed to document the delineation of employment duties from degree-seeking research work. Changes in a Student's Advisory Committee Changes in a student's Advisory Committee will be granted only on approval of all committee members (new and old) and on recommendation by the Department Head or Graduate Program Director, after the Change of Committee/Advisor Request form is completed and signed (https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Change_of_Committee-Advisor_Request.pdf). In the case that one or more members does not approve the change in the membership of the Advisory Committee, an appeal may be made by either the student or a faculty member to the Department Head. If the Department Head considers the appeal to have merit, he/she may then ask the Graduate School for an exception to all members signing the form. If the Chair of an Advisory Committee leaves the university or retires during the student's degree program, the department should consult with the Dean's Office in the Graduate School to determine the most appropriate continuing committee composition for advising of the student to degree completion.

Scholarly Ethics and Integrity

All graduate students are expected to uphold the Virginia Tech Principles of Community and the Graduate School's Expectations for Graduate Education as well as the scholarly integrity and research ethics standards of their disciplines. Graduate students must complete degree program requirements for learning about 4 required scholarly ethics and integrity topics plus additional topics relevant to the discipline as follows.Required topics: Plagiarism and other violations of the Graduate Honor Code Proper use of professional conventions in citation of existing research and scholarship, accurate reporting and ownership of findings, and acknowledgement of contributions to the work Ethical standards in teaching, mentoring, and professional activities Available avenues for reporting alleged misconduct Additional topics, as relevant to the discipline: Appropriate lab procedures and maintenance of lab notebooks and other research documentation Fair use of publications, software, and equipment Appropriate research protocols involving human and animal subjects; Institutional Review Board and/or Institutional Animal Care and Use Committee certification Guidelines for maintenance of confidentiality (and, where relevant, anonymity) in research Guidelines for determination of authorship Appropriate grant and contract management, including appropriately asserting personal or program capacities and competencies when applying for grants and contracts Discipline or fieldspecific professional ethics

Inclusion and Diversity

Prompted by the adoption of Commission on Graduate Studies and Policies Resolution 2017-18A, "Resolution to Incorporate an Inclusion and Diversity Education Component into Graduate Education," all Virginia Tech graduate programs have been expected to identify training modules suitable for students in their respective disciplines. Consistent with the Principles of Community, these training experiences are intended to reflect Virginia Tech's commitment to an inclusive graduate education for all students and promote ut prosim (service). Akin to the training in Scholarly Ethics and Integrity, the training plans address a set of required topics and a set that may be adapted to each program's needs.Required Topics: The Virginia Tech Principles of Community as they apply to the valuing of human diversity and inclusion. The impact that personal actions and words have on self, others, and the communities—university, national, and global—in which we live; issues of privilege, bias, power, prejudice, and discrimination; concepts of multiple personal, social, and cultural identities. Available avenues of redress and our shared responsibilities as active by-standers. The process of individual introspection required both to understand one's own forms of implicit or unconscious bias and to create inclusive environments. Additional Topics/Focus Areas (as appropriate to the particular academic unit): Inclusion and Diversity in a global context; institutional and governmental policies affecting immigration, accessibility, affordability, and related matters. Historical perspectives on diversity and the impact of traditions of privilege on the development of the discipline represented by the particular academic unit; inclusive pedagogy. Effective strategies for inter- or intrapersonal conflict resolution; pathways to individual reconciliation of unconscious or implicit bias. A list of the approved Inclusion and Diversity training plans may be found on the Graduate School website here: https://graduateschool.vt.edu/academics/programs/inclusion-diversity-req.html. Students should indicate on their Plans of Study the manner in which they have already or intend to meet the requirement.

Credit Hour Requirements for Degrees and Certificates

Master's Degree

Virginia Tech allows for both thesis and non-thesis master's degrees. For each degree type, the student's Plan of Study must meet the semester credit hours requirements shown below. Departments/programs may have additional requirements and an advisory committee may add specific requirements needed for an individual student's academic development. Graded credits must be taken for an A/F grade unless the course is only offered P/F (see Grading System Requirements). See Transfer Credit for policies about the transfer of graduate credits for use on the Plan of Study. See Undergraduates taking Graduate Courses for policies allowing Bachelor/Master's students at Virginia Tech to transfer some courses from the bachelor's degree to the master's degree (also referred to as double counting courses toward both degrees). Thesis Master's Minimum total credits: 30 credit hours Minimum graded credits: 20 credit hours May include a maximum of 6 credits of Virginia Tech 4000-level undergraduate course work The 6 credits of Virginia Tech 4000-level course work may include Special Study (4984) courses but may not include Undergraduate Independent Study (4974) or Undergraduate Research (4994) courses. All other graded course work must be 5000 level or higher (i.e., graduate course work) The 5000-level course work may include a maximum of 6 credits total in 5974, 5984, and 6984 courses and 3 credits of seminar. Some departments have approval from the Commission on Graduate and Professional Studies and Policies to reduce the minimum number of graded course work credits required for a specific degree program. See departmental degree requirements to determine if a department has approval for such changes in requirements. Minimum research credits: 6 credit hours of Master's Research (5994) taken at Virginia Tech. Non-thesis Master's Minimum total credits: 30 credit hours Minimum graded credits: 24 credit hours May include a maximum of 6 credits of Virginia Tech 4000-level undergraduate course work The 6 credits of Virginia Tech 4000-level course work may include Special Study (4984) courses but may not include Undergraduate Independent Study (4974) or Undergraduate Research (4994) courses. All other graded course work must be 5000 level or higher (i.e., graduate course work) The 5000-level course work may include a maximum of 9 credits total in 5974, 5984, and 6984 courses and 3 credits of seminar. Maximum project and report or research credits: May include a maximum of 6 credits of Project and Report (5904) credits taken at Virginia Tech

Second Master's Degree

Second Master's Degree (both degrees at Virginia Tech). The requirements for a second master's degree (after the first master's has been completed) are the same as for the first master's degree: an additional 30-54 hours, depending on the degree sought. No more than 50% of appropriate graded course work, to meet the requirements for a master's degree, may be common to both degrees. For example, if one master's degree requires 20 credits of graded coursework and the other requires 30 credits of graded coursework, no more than 10 credits (50% of the graded work on the degree with lower graded credit requirements) can be used toward both degrees. No Research or Project and Report credits from the first master's degree can be used for the second master's degree. No credits can be triple-counted. If the first master's degree is from another university, see Transfer Credits.

Simultaneous Degrees

If a student wishes to pursue two graduate degrees in different departments simultaneously, an Application for Simultaneous Degree must be submitted https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Application_for_Simultaneous_Graduate_Degree.pdf . No more than 50% of appropriate graded course work requirements for a master's degree may be common to both degrees. For example, if one master's degree requires 20 credits of graded coursework and the other degree requires 30 credits of graded coursework, no more than 10 credits (50% of the graded work on the degree with lower credit requirements) can be used toward both degrees. No Research or Project and Report credits from one degree may be counted toward the other degree. No credits can be triple-counted.

Education Specialist Degree (Ed. S.)

The Education Specialist Degree (Ed.S.) is a post-master's program requiring 60 credit hours. The program consists of 30 credit hours (minimum) from Virginia Tech and up to 30 credit hours of transfer credit from the master's degree. At least 21 credit hours must be completed at Virginia Tech after acceptance into the Ed.S. degree program. In this program, candidates are expected to attain a broad and systematic understanding of professional education, a definitive knowledge of a particular field of specialization and the ability to integrate and apply theoretical concepts of education in an actual educational context. This graduate program is designed for the accomplished, experienced practitioner with special professional aspirations beyond the masters, but who generally does not wish to pursue a doctorate. The Ed.S. is designed to meet this need and is offered in several specialty areas.

Doctoral Degrees

Doctor of Philosophy (Ph.D.) Doctoral degrees at Virginia Tech must meet the semester credit hour requirements listed below and include a dissertation that involves original research/scholarship.

Departments/programs may have additional requirements and an advisory committee may add specific requirements needed for an individual student's academic development. Graded course work on the Plan of Study must be taken for an A/F grade unless the course is only offered P/F (see Grading System Requirements). Students can apply graded coursework credits taken at Virginia Tech for a master's degree at Virginia Tech to a doctoral plan of study in the same program area if the Advisory Committee considers the courses appropriate for the doctoral degree. No Research and Thesis or Project and Report credits from a master's degree can be used for a doctoral plan of study. See Transfer Credit for policies about the transfer of graduate credits for use on the Plan of Study. Minimum total credits: 90 credit hours Minimum graded credits: 27 credit hours The Plan of Study may include a maximum of 6 credits of Virginia Tech graded 4000-level undergraduate course work. The 6 credits of Virginia Tech 4000 level course work may include Special Study (4984) courses but may not include Undergraduate Independent Study (4974) or Undergraduate Research (4994) courses. All other graded credits must be at the 5000 level or higher (i.e., graduate course work). Some departments have approval from the Commission on Graduate and Professional Studies and Policies to reduce the minimum number of graded course work credits required for a specific degree program. See departmental degree requirements to determine if a department has approval for such changes in requirements. The 5000-level course work may include a maximum 18 credits total in 5974, 5984, and 6984 courses and 4 credits of seminar. Minimum research credits: 30 credit hours of Doctoral Research (7994). Doctor of Education (Ed.D.) The Graduate School course work requirements for the Ed.D. are the same as those listed above for the Ph.D. with the exception that the minimum number of Research and Dissertation 7994 credits is 24.The dissertation for the Ed.D. typically demonstrates the candidate's ability to investigate phenomena in educational institutions or service agencies to increase practitioners' understanding of practical problems and issues.

Residency Requirements for Doctoral Degrees

Doctoral Degrees Virginia Tech offers four doctoral degrees: the Doctor of Philosophy (PhD), the Doctor of Education (EdD), the Doctor of Veterinary Medicine (DVM), and the Doctor of Medicine (MD). The PhD and EdD degrees are offered through the Graduate School, the DVM is offered through the Virginia-Maryland College of Veterinary Medicine, and the MD is offered through the Virginia Tech Carilion School of Medicine. The PhD is a research degree that focuses on “basic research that expands the knowledge base of the field” while the EdD is focused more on “applied research related to professional practice” (Council of Graduate Schools, CGS, 2005). The nature and purpose of the PhD is described as the following (CGS, 2005): “The Doctor of Philosophy program is designed to prepare a student become a scholar: that is, to discover, integrate, and apply knowledge, as well as to communicate and disseminate it. Such skills may lead to careers in social, governmental, educational, biomedical, business, and industrial organizations as well as in university and college teaching, research and administration. The PhD. Program emphasizes the development of the student’s capacity to make significant original contributions to knowledge in a context of freedom of inquiry and expression. A well-prepared doctoral student will have the ability to understand and critically evaluate the literature of the field and to apply appropriate principles and procedures to the recognition, evaluation, interpretation and understanding of issues and problems at the frontiers of knowledge. The student also will have an appropriate awareness of and commitment to the ethical practices appropriate to the field.” (p. 1) In accordance with the definition of doctoral degrees as involving mastery of intellectual principles, development of original scholarly contributions to the chosen field or fields, and critical evaluation of issues and problems in relevant disciplines, residency is required for all doctoral students at Virginia Tech. Doctoral Residency Guidelines Residency allows students to concentrate focused time on their degree, acquire the necessary “habits, attitudes, skills, and insights” (CGS, 2005) required for contributions to scholarship, and have opportunities to work closely with other scholars including faculty and other graduate students. These scholarly skills, attitudes, and experiences go beyond acquiring knowledge in classes and beyond experience in professional practice. The Graduate School expects all graduate programs to encourage and provide opportunities for immersion of doctoral students in scholarship. Residency goals can be achieved by multiple means, including but not limited to individual and group research training; providing access to resources such as libraries, research equipment, scholarly materials, and laboratories; providing networking opportunities with Virginia Tech and external scholars and graduate students; participation in scholarly seminars presented by scholars from Virginia Tech or elsewhere; assisting with developing applications for external funding of scholarly endeavors; participation at scholarly conferences; and publications or other forms of scholarly dissemination. Residency for doctoral degree programs (PhD, EdD) can be accomplished through one of three mechanisms. Two consecutive semesters of full-time enrollment: Programs will be expected to provide opportunities during those two semesters to cultivate immersion in scholarship and achieve the goals of residency. Students completing residency via full-time enrollment should understand residency goals and plan not only to complete required courses, but also to sustain scholarly engagement and immersion in research, scholarship and professional development. Program-specific alternative residency plan: Academic degree programs may propose alternative methods by which enrolled students will achieve residency goals to be approved by the Graduate School. Program-specific alternatives may be proposed for doctoral degree programs offered outside Blacksburg or on the Blacksburg campus. Individual alternative residency plan: Proposals for alternative residency from individual students can be submitted for approval by the Graduate School. Each academic degree unit should determine the mechanism through which the doctoral students can satisfy the residency requirement. Academic units may utilize any or all of the three options as determined appropriate by the graduate program faculty. For existing degree programs, the enrollment-based requirement will serve as the mechanism unless a specific request is made for a program-specific alternative residency plan. For new degree programs, the mechanism for earning doctoral residency should be included in the proposal submitted for approval through the governance process. Proposals for alternative residency plans (program-specific, individual) should include a description of how the alternative plan will help achieve the purposes and goals of doctoral residency: Please provide strategies for each of the following goals: Disciplinary depth and breadth Access to a wide variety of classes and academic experiences in the student’s field and in related disciplines Access to library, information technology, and laboratory resources Quality and rigor of the program through involvement with and scrutiny by peers in other disciplines Scholarly immersion Development of the student’s capacity to make significant original contributions to knowledge in a context of freedom of inquiry and expression (e.g., individual and group research training, assisting with developing applications for external funding, participation at scholarly conferences, publications or other forms of scholarly dissemination). Ability to understand and critically evaluate the literature of the field and to apply appropriate principles and procedures to the recognition, evaluation, interpretation and understanding of issues and problems at the frontiers of knowledge. Professional socialization Substantial interaction with a large pool of faculty to obtain scholarly and disciplinary advice, perspective, and guidance Interaction with fellow graduate students on professional issues Provision of a broad range of professional development experiences to guard against over-specialization Access to a wide spectrum of seminars, professional presentations, and contact with leaders in their own discipline as well as others Professional practice Awareness of and commitment to the ethical and regulatory principles and practices appropriate to the field. Program-specific alternative residency proposals should clearly identify the various methods the program will utilize to promote scholarly immersion and achieve the goals of residency as discussed above. The plan should consider the goals of residency and outline the ways these will be achieved, including specific activities and the timeframe as appropriate during which residency will be completed. Program-specific alternative residency plans should be submitted by the academic unit to the Graduate Dean for review and approval. Proposals should be submitted at least one semester before the desired effective date for implementation. Proposals will be reviewed and feedback provided within 30 days of submission. As needed, initial proposals can be revised for final review and approval. In addition, programs can submit revised or updated plans if elements of the degree program change. Individual alternative residency proposals must be submitted by the student and faculty advisor/committee as appropriate to the Graduate School for review and approval. Students should begin planning with their advisors early in their degree programs. Individual alternative residency plans must be submitted to the Graduate School as early as possible or at the latest, concurrent with submission of the Plan of Study. Alternative residency will be approved by the Graduate Dean before approval of the Plan of Study Recording of residency plans: All doctoral students should indicate the mechanisms by which they plan to earn residency on the Plan of Study form. Should a change in residency plan be required, students can seek approval of such change via the Plan of Study Change form accompanied by relevant documentation. Second Doctoral Degree A student who is seeking a second doctoral degree, regardless of whether the first was earned at this university, must earn a minimum of 48 additional semester credits and must satisfy the residency requirements specified for the doctoral degree at Virginia Tech. No credits can be triple-counted.

Graduate Certificates

Graduate certificates can be awarded to individuals who do not desire to work toward a degree as well as to students who are working on graduate degrees. Of the graduate course work (5000-level or higher courses) for the certificate, at least 2/3 must be graded course work taken on the A/F grading option. Certificates must include a minimum of 9 credit hours of Virginia Tech graduate course work credits. No transfer credits can be applied to graduate certificates. No more than 50% of the credits for a particular graduate certificate can be double-counted toward another graduate certificate, and credits for a particular course cannot be counted toward more than two certificates. All credits for a graduate certificate can duplicate credits on a degree plan of study. All grades for certificate courses must be "C" or higher and the overall certificate GPA must be 3.0 or higher. The specific requirements for each certificate can be found on the Graduate School Certificate Page: https://secure.graduateschool.vt.edu/graduate_catalog/certificates.htm. Certificate candidates must be admitted to the Graduate School and formally accepted to the certificate program: http://graduateschool.vt.edu/admissions/how-to-apply.html Upon successful completion of certificate requirements, an Application For Certificate Conferral https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Degree-Certificate_Conferral_Request.pdf must be signed by the department and submitted by the Application for Degree deadline in the term in which the certificate will be awarded. Meeting this deadline is necessary for the student's name to appear in the commencement bulletin. http://graduateschool.vt.edu/academics/commencement_deadlines.

Examinations

All graduate examinations are open to the faculty and faculty members are encouraged to attend and participate in such meetings. The student must be registered during the semester in which any examination required by Graduate School Policies is taken.

Scheduling Examinations

Scheduling Examinations: Examinations required by Graduate Policies and Procedures (Preliminary and Final Examinations), are scheduled through the Graduate School. https://ess.graduateschool.vt.edu Requests to schedule examinations must include the time, date, building and room number, title of dissertation or thesis, and the names and signatures of the Examining Committee. These requests are due in the Graduate School at least two weeks before the examination date requested. Notification of the approval of the examination scheduling will be sent electronically to the student and all members of the Examining Committee. The examination should not be conducted if the Advisor has not received notification that the examination has been scheduled. The examination result should be entered in the Electronic Signature System within 2 days after the examination, with each committee member signifying whether the exam performance was Satisfactory or Unsatisfactory. Preliminary examinations and non-thesis final examinations can be scheduled through the last day of exams for the term. Final examinations for master's thesis and doctoral students must be scheduled early enough in the term to meet the final ETD submission date. Before filing the request for scheduling an examination, the student's record should be reviewed by the department to make sure that the Plan of Study has been filed and approved and that there are no problems. The Graduate Program Director's signature on the form is the departmental verification that the Plan of Study has been examined and that it is appropriate for the student to schedule the examination. For Preliminary Examinations, which commonly are comprehensive examinations of the doctoral coursework, typically students complete the formal coursework on the Plan of Study prior to taking the exam. If a student has coursework remaining to be taken, the department should determine whether or not it is appropriate for the student to take the examination before all the graded coursework on the Plan of Study is completed. Students may take the Preliminary Examination despite having some grade problems on the Plan of Study (e.g., Incompletes, grades <C- that require retaking a course) but the student's Advisory Committee should address whether this will put the student at a disadvantage on the exam. If the decision is to schedule the exam in a case like this, a note addressing the committee's decision to move forward with the exam should accompanying the exam request. By the end of the degree, all grades on the Plan of Study must be a C- or higher and the Plan of Study and overall GPA must be 3.0 or higher. For scheduling of the Final Examination, Thesis Master's and Ph.D. students must have the thesis/dissertation ready for defense (as judged by Advisory Committee members having read the document and signed the examination scheduling request) and the student must be able to complete all other degree requirements within the semester when the examination is held: all coursework on the Plan of Study will need to be completed with grades of C- or higher and both the Plan of Study GPA and the overall GPA must be a 3.0 or higher by the end of the semester. Because some of the problem situations with deficient grades or credits require retaking courses or adding credits, the Plan of Study should be examined at the beginning of the semester in which a student plans to take the Final Examination. For Non-thesis Master's students, scheduling of the Final Examination requires that the student will be able

to complete any Project and Report or Independent Study requirements, complete all coursework on the Plan of Study with grades of C- or higher and attain a Plan of Study and overall GPA of 3.0 or higher by the end of the semester. Students wishing to schedule the Final Examination, who have not been enrolled at Virginia Tech for more than a year, need to file for Readmission and allow enough time for any problems to be resolved so they can be Readmitted prior to the 2 week period needed for Exam scheduling. The minimum enrollment is 3 cr. For enrollment requirements when taking a Final Examination, see below. Required examinations are administered during regular academic semesters or sessions, i.e., between the first day of classes for a given semester or session and ending with the last official day for examinations. Permission to schedule an examination in the time between sessions may be granted if an explanation of special circumstances requiring that scheduling is made to the Dean's office of the Graduate School by the student's Advisor. Scheduling of examinations between semesters/terms does not alter ETD submission or approval deadlines.

Examining Committees

At least four scholars eligible to serve are required to participate on every doctoral Advisory Committee, and at least three are required for every master's Advisory Committee. All members of a student's Advisory Committee are required to participate in that student's doctoral (preliminary and final) or master's (final) examinations. If one of the Advisory Committee members cannot participate, the committee member should recommend to the Chair of the Advisory Committee, when possible, the name of a scholar eligible for advisory committee membership to serve as a proxy on the Examining Committee. After consultation with the student, the Chair of the Advisory Committee makes such a proxy appointment in writing. Regardless of the size of the size of the Committee, only one official proxy will be approved. Those conducting the examination must log in to the Electronic Signature System and enter their decision on the exam result within 2 days after the exam. The proxy must communicate with the committee member for whom he or she is serving as a proxy regarding the exam result decision and the original committee member must log in to the Electronic Signature System and enter the decision. All committee members must also signify approval or disapproval of the thesis/dissertation in the Electronic Signature System. This signifies that the thesis or dissertation is in final form and ready for ETD submission to the Graduate School.

Successful Completion of Required Examinations

To pass any of the required examinations, a graduate student is allowed at most one Unsatisfactory vote. If a student fails an examination, one full semester (a minimum of 15 weeks) must elapse before the second examination is scheduled. Not more than two opportunities to pass any one examination are allowed. A student failing any of the examinations required by Graduate Policies two times will be dismissed from graduate studies by the Graduate School.

Final Examination (Master's)

An oral and/or written final examination or evaluation is required in all master's programs (see departmental policy for specific format). For some non-thesis master's programs, final exams are structured in special ways, including evaluation of a project as the final examination. For non-thesis, coursework-only master's degree programs, the committee will conduct a final evaluation of the student's record to confirm degree completion. All master's final examinations and non-thesis, coursework only evaluations are scheduled through the Electronic Scheduling System. For more information about master's final examinations, consult the departmental policies and procedures document.

Qualifying Examination (Doctoral)

Certain departments require doctoral students to take a qualifying examination (see departmental policies). The results typically are used to evaluate subject mastery, to determine deficiencies, and to determine whether the student should continue into dissertation research. The results of qualifying examinations are made part of the student's departmental record. Qualifying examinations are not scheduled through the Graduate School.

Preliminary Examination (Doctoral)

The Preliminary Examination is a requirement for all doctoral students. This examination must be taken at least 6 months before the Final Examination. The Preliminary Examination may be oral or written, or both. Schedule the exam at this site: https://ess.graduateschool.vt.edu. The examination date requested should coincide with the date when the decision about the student's performance is made. If the Preliminary Examination consists of a written section followed by an oral examination, the examination date requested should be the date of the oral. The results should be reported to the Graduate School within 1-2 days of the decision about the examination. If an Advisory Committee member cannot participate, the committee member should recommend to the Chair of the Advisory Committee, when possible, the name of a scholar eligible for advisory committee membership to serve as a proxy during the examination. After consultation with the student, the Chair of the Advisory Committee makes such a proxy appointment in writing. Regardless of the size of the size of the Committee, only one official proxy will be approved. Individual departments may choose to administer the Preliminary Examination as a written departmental examination for a group of doctoral students. In this case the examination is typically administered by a committee with all members certifying the results to the department. After the results are certified to the department, the members of each student's Advisory Committee, including any proxies, must record approval/disapproval in the Electronic Signature System.

Final Examination (Doctoral)

Final Examination (Doctoral) All doctoral candidates must take a final oral and/or written examination, which is at minimum a defense of the dissertation. See Advisory Committee Approval of Thesis or Dissertation for a full explanation. This examination must be scheduled no earlier than six months after successful completion of the preliminary examination. https://ess.graduateschool.vt.edu To be eligible for hooding at Commencement, the Final Examination must be completed and the Electronic Thesis/Dissertation (ETD) must be approved by the Graduate School by the published deadline for the semester: http://graduateschool.vt.edu/academics/commencement_deadlines

Enrollment and Examinations

Enrollment and Examinations The minimum enrollment for students working on writing their thesis/dissertation (including consulting with their advisor and/or committee during a semester or summer session) is 3 credit hours. Graduate students must be enrolled for the minimum number of credits in the semester or summer session in which they take an exam and in the semester in which they complete a degree: 3 credit hours during a semester or summer session 1 credit hour for students who qualify for Start of Semester Defense Exception (SSDE, see below) in the semester of their final exam Qualifying for Start of Semester Defense Exception Start of Semester Defense Exception (SSDE) is a special enrollment category for students who have fulfilled all requirements, including advisory committee review and agreement that the thesis or dissertation is ready for defense, and are registering only to take the final oral examination. To qualify for start of semester defense exception, a student must have: completed all requirements (including passing grades on all courses on the plan of study), except for the final exam and submitted the final copy of the thesis/dissertation to the advisory committee within the first three weeks of the semester and at least two weeks before the defense and received permission from the advisory committee, who have read the document and consider it ready for defense (to the extent that the student can make corrections and submit the ETD within two weeks of the defense) within the first three weeks of the semester and been enrolled in at least three credit hours the preceding semester and submitted the SSDE form to the Graduate School by the Friday of the third week of classes or no later than three weeks prior to the defense, whichever date comes first Scheduling a Final Exam within the Start of Semester Defense Exception Timeline To defend under SSDE, a student must schedule and attend the defense according to the following timeline: Within the first three weeks of the semester: Submit SSDE form to the Graduate School Wait for the Graduate School to enroll student in 1 cr (students cannot enroll themselves) Submit Application for Degree in HokieSPA Submit Request for Final Examination (at least two weeks prior to the exam date) in the Electronic Signature System Within the first five weeks of the semester:

International students who qualify for SSDE must defend (complete final exam) to maintain immigration status. Understanding Potential Implications of Start of Semester Defense Exception If a student registers for SSDE, his/her enrollment status will be less than full time, which may affect the following: financial aid or loan deferments employment opportunities (not eligible for assistantships or fellowships) visa status (for international students) Students should consult with the Graduate School and/or Office of Scholarships and Financial Aid to understand the consequences and additional requirements that may result from enrolling under start of semester defense exception.

Graduation

Procedures for Graduation

Students anticipating degree or certificate completion must file an Application for Degree (AFD) through the Graduate Student Degree Menu in HokieSPA. Students who earn more than one degree and/or certificate in a semester must use the Degree-Certificate Conferral Request form (the paper equivalent of the AFD form in HokieSPA) for the additional degree/certificate after submitting the first request through HokieSPA. Deadlines for those wishing to complete their degrees in time to attend Commencement are posted at http://graduateschool.vt.edu/academics/commencement_deadlines.

Graduation Clearance Procedures

Summary of Procedures Summary of Procedures for a candidate for the master's or doctorate degree: 1. Students must be enrolled at Virginia Tech in the term in which the degree is awarded. 2. Filing of Application for Degree, payment of fee. This form makes an individual degree completion checklist available to the student on Hokie SPA. It must be submitted prior to the last day of classes of the term in which the student intends to graduate.3. Submission of the Request to Schedule Final Examination, two weeks before the proposed examination date for students who have been enrolled during the last year. For those who have been out of residence for more than a year, and require Readmission, the Readmission process should be completed before requesting the Final Examination. 4. Taking Final Examination. 5. Submitting the final version of the thesis or dissertation, approved by the student's Advisory Committee through the Electronic Signature System, as an Electronic Dissertation or Thesis (ETD) within two weeks after the defense. 6. Submitting any applicable supporting documentation for the ETD (e.g., copyright permission letters to reproduce items from other publications, Institutional Research Board approval or exemption notices (if appropriate), UMI form, Survey of Earned Doctorates). 7. Payment of the archiving fee which is required of students at the time the ETD is submitted. 8. Degree Completion requires ETD approval by the Graduate School and completion of all other requirements for the degree.

Commencement Participation

Master’s students who have completed their degree requirements, and those nearing completion, can participate in Commencement. However, diplomas are not issued until all degree requirements are met. Summer graduates may attend either fall or spring commencement but must confirm their attendance through Hokie SPA. Doctoral candidates, to be eligible to participate in the doctoral hooding ceremony, must have completed all degree requirements including ETD approval by the Graduate School by the deadlines published each semester on the Graduate School website: http://graduateschool.vt.edu/academics/commencement_deadlines

Academic Regalia

Information on master’s and doctor’s regalia is available from the University Bookstore, Clothing and Gifts department, 540/231-5991 http://www.bookstore.vt.edu

Degree Conferring Dates

In addition to the traditional twice-a-year commencement, two additional "Degree-Conferring Dates" have been established. These dates appear on the diploma for qualified graduates. These additional degree-conferring dates fall on the last day of final examinations of First Summer Term and Second Summer Term. No commencement ceremonies are conducted during the summer. Students who complete degree requirements during summer may attend the next commencement; students must confirm commencement attendance via Hokie SPA. All degrees conferred between commencements are listed in the next commencement program. Diplomas will be mailed to graduates by first class mail.

Thesis and Dissertation

Master's degrees

Master’s degrees may be thesis or non-thesis and this is specified on the Plan of Study at the time the plan is submitted. For departments where the non-thesis option is available, a master’s degree candidate is allowed to change from the thesis to the non-thesis option (or vice versa) only once. A change between thesis and non-thesis requires the filing of a Thesis Option Change form https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Thesis_Option_Change_Request.pdf

Doctoral degrees

Doctoral degrees (Ph.D. and Ed.D.) require a dissertation that involves original research.

Independent Effort

Two or more students may work on the same total problem; however, each student must prepare an independent thesis or dissertation on that student's part of the problem. The individual contributions of each student involved in the same problem should be explained in each thesis or dissertation.

Dissertation Format

Dissertations may be prepared in the traditional multi-chapter format or in manuscript format (minimum of two journal articles, plus front and back matter as indicated in the guidelines). http://etd.lib.vt.edu/etdformats.html

Proprietary or Classified Theses and Dissertations

In certain instances a portion of students' thesis or dissertation research might involve proprietary, controlled, or classified information. Although some results might need to be summarized for the sponsor in a separate embargoed document, a completely embargoed thesis or dissertation conflicts with scholarly values of peer review and promotion of knowledge and should be avoided. All theses and dissertations produced to meet Virginia Tech degree requirements should be subject to an open defense and open publication (including ETD submission), and capable of standing as academically-complete works. Since any proprietary or governmental restrictions should be known at the outset, students are expected to seek a pre-research review of their thesis or dissertation plans with the sponsor whenever there is a possibility that certain findings might be subject to embargo. In coordination with the Chair of their Advisory Committees, students should communicate to the Graduate School as soon as possible any anticipated restrictions on their research. Similarly, a pre-publication review should be conducted with the sponsor as early as is prudent to identify any restrictions on publication, including acceptable separation of restricted findings into an embargoed document. Any publication restrictions should be communicated to the Graduate School as soon as they are known or predicted.

Advisory Committee Approval of the Thesis or Dissertation

All members of a student's Advisory Committee are required to participate in that student's final examination. Depending upon the technological resources available, committee members may participate from a remote location. If an Advisory Committee member cannot participate, the committee member should recommend to the Chair of the Advisory Committee, when possible, the name of a scholar eligible for advisory committee membership to serve as a proxy during the examination. After consultation with the student, the Chair makes such a proxy appointment in writing. Regardless of the size of the advisory committee, only one official proxy will be approved. Those conducting the examination must log in to the Electronic Signature System and enter in their decision on the exam result. The proxy must communicate with the committee member for whom he or she is serving as a proxy regarding the exam result decision, and the original committee member must log in to the Electronic Signature System to enter the decision on behalf of the proxy. All committee members must also signify approval or disapproval of the thesis/dissertation in the Electronic Signature System. This signifies that the thesis or dissertation is in final form and ready for ETD submission to the Graduate School. If a committee member does not approve the thesis/dissertation, that non-approval will be designated on the ETD. A successful candidate is allowed, at most, one negative vote, regardless of the size of the Advisory Committee.

Electronic Thesis and Dissertation (ETD)

Theses and dissertations are submitted electronically. For instructions, see https://guides.lib.vt.edu/c.php?g=547528&p=3756956.

Deadline for ETD Submission

The final version of the thesis or dissertation approved by the student's Advisory Committee must be submitted electronically as an ETD to the Graduate School no later than two weeks after successful completion of the final examination. The ETD Approval Form, indicating Advisory Committee approval of the document must be returned to the Graduate School when the ETD is submitted. If the process of ETD revisions leading to Graduate School approval of the ETD extends beyond the posted deadlines for a semester, the student will be enrolled for 1 credit of SSDE in the later semester when degree completion occurs. http://graduateschool.vt.edu/academics/commencement_deadlines

Degree Completion and Graduate School Approval of the ETD

Degree Completion Graduate degrees are completed after the approval of the ETD by the Graduate School and the completion of all other requirements for the degree.

Copyrighting and Microform

The Graduate School does not require students to register their copyright. ProQuest (previously University Microfilms), digitizes abstracts in their book Dissertation Abstracts and also digitizes the dissertations http://il.proquest.com/brand/umi.shtml If a master's student wishes to register the copyright, they must apply directly through the Library of Congress Copyright Registration Office. More information concerning the requirements and cost of copyright registration can be found at http://copyright.gov/eco/

Intellectual Property

A University Intellectual Property Policy was adopted in 1986 by the university’s Board of Visitors. The policy applies to copyrightable material, patentable inventions, and other creations conceived by any faculty member, staff member, or student employee when substantial university resources, such as money or equipment, are used in connection with the conception and/or development of the creation. All such creations are the property of the university and subject to any applicable agreements with funding agencies. If a student employee has conceived a creation, which may belong to the university pursuant to the Intellectual Property Policy, it is his or her responsibility to report promptly the creation to the university. All creations must be reported to the Office of the Vice President for Research. Creations must be reported before publication of the item, or before publication of information relative thereto or before disclosure to an outside firm or agency. Under the existing policy, net income to the university in the form of royalties (etc.) from the creation may be shared equally with the creator(s). Copies of the Intellectual Property Policy and assistance in reporting creations may be obtained from the Office of the Vice President for Research http://www.research.vt.edu/ or http://www.vtip.org/

Appeals

Graduate Student Appeals

[See additional information in Expectations for Graduate Education: Complaints and
Appeals, http://graduateschool.vt.edu/academics/expectations/expectations-for-graduate-education-overview/complaints-and-appeals.html]
Graduate education is a complex activity involving a high order of student-faculty relationship. It follows that the evaluation of the graduate

student’s progress is, and must be, dependent in large part on the judgment of the student’s Advisor and augmented by the collective judgment of the members of the Advisory Committee. The university, through the Graduate School, defines minimal entrance standards and general rules governing eligibility for continuation in graduate programs. However, the crucial agency in student evaluation is the student’s Advisor and other Advisory Committee members. It is important that each graduate student be fully informed, not only of the Graduate School Policies and Procedures, but of any additional departmental program requirements beyond those of the Graduate School. The Graduate School website provides a link to departmental policy requirements at https://secure.graduateschool.vt.edu/graduate_catalog/programs.htm . The department should inform graduate students of their degree requirements at the time of matriculation. It is assumed that most problems involving graduate education will be discussed informally and reconciled at the departmental level. Indeed, most discussions of this kind will commonly occur among the student, the Chair of the student’s Advisory Committee, and the other members of the Advisory Committee. However, from time to time serious questions may arise that place the student’s status in jeopardy. On these occasions, it is important that the university provide full opportunity for the student’s grievance to be reviewed in a judicious manner.

The Departmental Appeal

When a graduate student believes that any work has been improperly evaluated, or believes that there has been unfair treatment, it is expected that the student will take up the questions directly with the faculty member involved. This may be the student’s Advisor, other faculty members, or an instructor responsible for a course. If, after earnest inquiry, the matter remains unreconciled, the graduate student will be expected to appeal the question to the Department Head (the Graduate Program Director also may be involved in this level of appeal). If the Department Head is a party to the grievance, the Dean of the academic college will assume this responsibility. The Department Head, in consultation with the college Dean, shall take all reasonable and proper actions to resolve the question at the departmental level. The student shall be informed in writing of the results no later than one month after the appeal to the Department Head. In some matters, the Faculty Handbook provides additional relevant information, for example, "the assigning of grades is the responsibility of the individual instructor in every case. The basis on which grades are assigned rests on his/her judgment alone....").

The University Appeals Procedure

Should the aggrieved student believe that the student's rights were abridged at the departmental level, the student may file an appeal with the Dean of the Graduate School. In a statement to the Dean, the aggrieved student must clearly state the substance of the appeal. The Dean of the Graduate School shall take all reasonable and proper actions to resolve the question or refer it directly to the Graduate Appeals Committee for its review. As a standing committee of the Commission on Graduate and Professional Studies and Policies, this committee will consist of three faculty members and one graduate student. For each appeal the dean shall appoint to the committee one additional faculty member knowledgeable in the academic area of the appeal.The review by the Graduate Appeals Committee will have available to it all pertinent information in the student’s record in the university and (a) the department’s policy statement concerning its degree expectations, (b) a summary of the department’s action on the appeal, and (c) copies of the student’s statement to the Dean of the Graduate School recording the student’s view of alleged irregularities (i.e., the basis for university appeal).The Graduate Appeals Committee may hold a formal hearing on grievance appeals referred to it by the Dean of the Graduate School. The hearing will be conducted with the following procedural safeguards:1. All parties to the dispute will be notified of the time and place of the hearing at least 48 hours in advance;2. The aggrieved student will be permitted, if the student chooses, to invite a member of the faculty or student body to represent him/her in the hearing;3. All parties in the dispute will be given full opportunity to testify and to present such evidence or witnesses as seem relevant;4. All matters on which the finding will be based must be introduced into evidence at the hearing. The Graduate Student Appeals Committee will make a recommendation to the Dean of the Graduate School, which will be acted upon by the Dean of the Graduate School in consultation with the Provost. The Dean will convey the committee’s recommendation and the final disposition of the matter to all concerned parties.

AEROSPACE ENGINEERING

Ella Atkins, Head

Professors: Ella Atkins; Jonathan Black; Stefano Brizzolara; Alan Brown; Robert Canfield; Olivier Coutier-Delgosha; William Devenport; Mazen Farhood; Rakesh Kapania; Kevin Lowe; Eric Paterson; Michael Philen; Mark Psiaki; Pradeep Raj; Shane Ross; Christopher Roy; Gary Seidel; Kevin Shinpaugh; Cornel Sultan; Craig Woolsey;

Associate Professors: Colin Adams; William Alexander; Scott England; Yao Fu; Christine Gilbert; Justin Jaworski; Luca Massa; Bhuvana Srinivasan; Kevin Wang; Gregory Young;

Assistant Professors: Riley Fitzgerald; Mathieu Joerger;

NAVSEA Professor of Naval Ship Design: Alan Brown;

Kevin Crofton Professor: William Devenport; Mark Psiaki;

Norris and Laura Mitchell Professor of Aerospace Engineering: Rakesh Kapania;

Rolls-Royce Commonwealth Professor of Marine Propulsion: Eric Paterson;

Research Associate Professors: Aurelien Borgoltz;

Professor of Practice: Harry Artis; William Butler;

Research Assistant Professors: Nanyaporn Intaratep; Jie Song;

Graduate Contact: gradadvise-g@vt.edu

Student Handbook:

https://www.aoe.vt.edu/content/dam/aoe_vt_edu/programs/graduate/forms/AOE_Graduate_P-P.pdf

Graduate Site: https://www.aoe.vt.edu/graduate.html

Master of Science Degree The Department of Aerospace and Ocean Engineering offers a Master of Science Degree in Aerospace Engineering and in Ocean Engineering. Each of these degrees has two options, a Master of Science with or without thesis. Although both degrees require the same number of credit hours for graduation, the thesis option requires some of these credits be devoted to a research project. The non-thesis option can be obtained by taking only course work, or it can include credits for a project and report. Such a project and report is generally not research oriented, but deals with other aspects of an engineering problem and may involve a team of students. In order to ensure that all our students can communicate with scientists and engineers outside their primary field of interest, all students take at least one course in the general areas of aerodynamics, structures, flight mechanics and control, and numerical methods. In addition, students in the non-thesis program are required to take additional courses in their area of study. Students in this program have the opportunity to work on advanced research projects in the three areas mentioned previously as well as in the interdisciplinary arena where familiarity with two or more disciplines is required. As a result many of our students are in a position to satisfy the rapidly growing demand for well rounded engineers and scientists. Students following the thesis route work with faculty that have both national and international reputations in their respective areas of research. These areas pose exciting new challenges to the students who have the opportunity to work closely with their faculty advisor on current problems. These problems reflect the latest interests in new advancements in science and technology by NASA, Navy, Air Force, and various aerospace and non-aerospace industries. Our masters students do significant hands-on research and often work in teams with other masters and Ph.D. students on wide-range of topics, some focused in a newly developing area, and some multidisciplinary in nature. These activities include state-of-the-art research in aerodynamics, structures, flight dynamics and control, and multidisciplinary analysis and design. Students are encouraged to present their research results at conferences and in archival journals tied to industry and/or government or sponsored projects and include interaction with personnel and facilities from those organizations.The requirements for the degrees focused on applied physics or applied mathematics are slightly different from those of the other categories in that some required courses from the Aerospace and Ocean Engineering Department are replaced with others from either Physics or Mathematics respectively. These programs are specially tailored for students whose backgrounds are from outside the engineering environment and are interested in applying their skills to solving aerospace problems. Such programs encourage interaction with disciplines outside the usual engineering environment and result in new approaches to analyzing and solving problems. Master of Engineering Degree The Aerospace and Ocean Engineering Department offers a Master of Engineering degree in Aerospace Engineering. This degree requires the completion of a project and report which in some cases is required to be in conjunction with other students. For the Aerospace Engineering Degree, students are required to take at least one course in each general area of aerodynamics, structures, and flight mechanics and control. This requirement is to insure that graduates from this program can operate in a multidisciplinary environment. In all cases the Master of Engineering program focuses on engineering type problems and their solutions. Doctor of Philosophy Degree The Aerospace and Ocean Engineering Department offers a Doctor of Philosophy Degree in Aerospace Engineering. This degree is a research oriented degree which can be focused toward one (or more) of several disciplines. These disciplines include Aero-Hydrodynamics, Dynamics and Control, Structures and Structural Dynamics, Ocean Engineering, Applied Physics, Space Engineering and Applied Math. All of these degrees require an in depth research project which will serve as the subject of the final dissertation. Research projects have been carried out in the areas of computational fluid dynamics (CFD), experimental fluid mechanics (both high and low speed), instrumentation development, composite materials, structural optimization, flutter analysis, nonlinear flight control, pilot- aircraft interactions, aerodynamic modeling, computer aided design, interdisciplinary design and optimization, trajectory analysis and optimization, space mechanics and space vehicle design, to name a few. Many of these programs are tied to industry and/or government sponsored projects and include interaction with personnel and facilities from those organizations. The requirements for the degrees focused on applied physics or applied mathematics are slightly different from those of the other categories in that some required courses from the Aerospace and Ocean Engineering Department are replaced with others from either Physics or Mathematics respectively. These programs are specially tailored for students whose backgrounds are from outside the engineering environment and are interested in applying their skills to solving aerospace problems. Such programs encourage interaction with disciplines outside the usual engineering environment and result in new approaches to analyzing and solving problems. Students in the PhD program work with faculty members known nationally and internationally for their contributions in their research area. Opportunities exist to work on the very latest research projects in the areas of aerodynamics, structures, flight dynamics and control, and multidisciplinary analysis and design. Many of these projects are in support of aerospace and non-aerospace industry, NASA, Navy and Air Force initiatives and include both analytical and experimental components. Modern computational and experimental facilities are available to each student including four subsonic wind tunnels and one supersonic wind tunnel. Advanced instrumentation is available for taking measurements of all type in these facilities.

SPECIAL FACILITIES

Research in Aerospace and Ocean Engineering poses exciting new challenges to the students who have the opportunity to work closely with their faculty advisor on current problems. These problems reflect the latest interests in new advancements in science and technology by NASA, Navy, Air Force, and various aerospace and non-aerospace industries. Our graduate students do significant hands-on research and often work in teams with other graduate students on wide-range of topics, some focused in a newly developing area, and some multidisciplinary in nature. These activities include state-of-the-art research in aerodynamics, structures, flight dynamics and control, and multidisciplinary analysis and design Students are encouraged to present their research results at conferences and in archival journals tied to industry and/or government sponsored projects and include interaction with personnel and facilities from those organizations.
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Aerospace Structures and Materials Laboratory (ASML)

The Aerospace Structures and Materials Laboratory (ASML) in the Aerospace and Ocean Engineering department at Virginia Tech is a research and educational facility dedicated to the understanding of structures and materials. The laboratory serves as an instructional center for students who are learning about structures related research at the undergraduate and graduate level. The facility is located in Room 15 of Randolph Hall.

Aerostructures Axial-Torsional Test Facility

This equipment is a large, multi-axial, servo-hydraulic testing machine purchased in 1988 from the MTS Systems Corporation (Eden Prairie, Minnesota), and it is located in 107 Hancock Hall. This machine is capable of simultaneously loading of test articles axially and torsionally, controlling either the axial load or axial displacement and controlling either torque or rotation. The computer automation (MTS TestStar workstation and Model 490 Digital controller) makes it possible to specify random independent biaxial loading on each axis in fatigue, or of a controlled phase relationship between each axis, or to input load spectrums obtained from field measurements, as well as providing data acquisition. The load unit has a fatigue load rating of 110,000 lbs axial and 50,000 lbs-in. torsional. The usable test space is 60 inches vertical spacing between actuator and load cell. Horizontal clearance between the load frame columns is 30 inches. The maximum stroke of the linear actuator is 6 inches, and the maximum rotation of the rotary actuator is 100 degrees.

Boundary Layer Research Wind Tunnel Laboratory

This research laboratory consists of a low-speed low-turbulence-intensity open-loop pressurized wind tunnel and associated equipment and instrumentation. Downstream of the blower a feedback-controlled rotating-blade damper can produce large-amplitude gusts up to 2 Hz, which is useful for simulating unsteady separating turbulent boundary layers in the test section. The test section is 3 feet wide and 24 feet long, has an adjustable upper wall that permits various streamwise pressure gradients, and has active suction and tangential wall-jet boundary controls on the non-test walls that are used to prevent unwanted stalls in strong adverse-pressure-gradient and unsteady flows. This facility has been used over the past 28 years in a number of experimental studies. Custom-designed and constructed laser-Doppler anemometers have been used. The results have revealed new features of the turbulence structure of turbulent boundary layers and separated flows. Recently Olcmen and Simpson (1995) developed a fiber-optic "5-velocity-component" laser-Doppler velocimeter system for measuring 3 velocity components simultaneously at one point (30 um diameter) and 2 other velocity components at 2 other points. Turbulent convective heat transfer in 3-D and separated flows have also been examined in this facility (Lewis and Simpson, 1996). Currently, this facility and instrumentation are being used to define the second-order turbulence structure of three-dimensional flows around hull/appendage and wing/body junctions.

Center for Space Science and Engineering Research

The Center for Space Science and Engineering (Space@VT) comprises a group of faculty, students and staff devoted to the investigation of the space environment. We presently include members from the Bradley Department of Electrical and Computer Engineering and the Department of Aerospace and Ocean Engineering. The Center resides in the College of Engineering. Our mission is to provide forefront research, instruction, and educational outreach in the fields of space science and engineering utilizing a holistic approach of theoretical modeling, advanced simulation techniques, space system and instrument design, and experimental data acquisition, analysis and interpretation.

Dynamic Plunge-Pitch-Roll Apparatus (DyPPiR)

The DyPPiR represents the next generation in wind tunnel testing methodologies: simulation of true unsteady aerodynamics. The DyPPiR is essentially a hydraulically powered, computer controlled, three degree-of-freedom robotic arm that is used to force sting mounted wind tunnel models through general, large excursion, high rate, high Reynolds number maneuvers. The DyPPiR is being used to study the maneuvering performance of submarines and fighter aircraft, and future work will involve even transient racecar aerodynamics. In addition to standard force and moment measurements, surface skin friction measurements (for three-dimensional separation location detection) and surface pressure measurements are made, and a Doppler Global Velocimeter (DGV) will permit 3-component velocity measurements to be made in a plane in the flow at specific instances during a maneuver.

Graduate Computational Laboratory

The computational requirements for Aerospace and Ocean Engineering are often very demanding. Students require access to graphical workstations, super-computers, networking applications, and document processing facilities. Graduate students in Aerospace and Ocean Engineering have access to a wide variety of computer facilities. In addition to those resources provided by Virginia Tech and the College of Engineering, the Department maintains personal computers, graphics workstations, and powerful servers. The Graduate Computer Laboratory includes workstations all of which are equipped with a wide variety of application software.

Hypersonic Wind Tunnel

The Virginia Tech blow-down type high-speed wind tunnel which operates at speeds ranging from Mach 2 to 7 is shown in Figures 1 and 2. The blow-down type wind tunnel offers run times on the order of a few seconds at high Mach numbers with relatively steady flow conditions. This facility was obtained through our close and long-term collaborations with the Institute of Theoretical and Applied Mechanics of the Russian Academy of Sciences in Novosibirsk, Russia. Air (or other working gas) is supplied from a compressor to charge the storage bottles visible within the frame at the bottom. A special fast-acting control valve initiates flow into the plenum chamber. The flow then passes through a contoured, converging-diverging nozzle and out through the diffuser. Due to the working principle of the tunnel and the fast-acting control valve, there is only a slow decrease in total pressure during the run. The variation of the total pressure during the run is in the range of approximately 10%. For Mach numbers above 4, an electric heater raises the total temperature up to 800 K to prevent liquefaction. The nozzle exit diameter is 100 mm. The test cabin arrangement permits the use of relatively large instream models, especially at the higher Mach numbers. This facility can be used for aerodynamic problem investigations which involve proper values of Mach and Reynolds number, to try out new measurement methods in high-speed flows, and for laboratory instruction of students. This laboratory type facility produces a gas flow with good metrology features, which are comparable to the corresponding features of steady flow in modern wind tunnels. -Working gases: air, nitrogen, argon, helium, and other safe gases. The total mass of storage air in 8*40 dm 3 bottles with pressure of 150 bars is 56 kg. Each run uses about 2.7 kg/s of pressurized gas. It is possible that standard bottles or a high-pressure compressor with low delivery (capacity) will be used as a working gas supply. The upper limit of stagnation pressure in the storage bottles is Pb = 15 MPa. The upper limit of stagnation temperature is To = 800 K. The minimal values of stagnation pressure Ps and temperature Ts within the test chamber and diffuser are Table No. 1. test section size is 100mm. -Electric heater (220/380 V) with capacity 15 - 20 kW provides the flow stagnation temperature up to 800 K to prevent condensation of air at hypersonic speeds. -Tested models usually have the length 200 - 300 mm at the angle of attack 00 - 100 and 80 - 120 mm at the angle attack up to 400 - 500. The diameter of tested models is 20 - 40 mm. -Inner dimensions of test chamber are 360*226*200 mm. -Run duration depends on the test conditions and is usually from 1.0 to 2.0 s. During this time the flow stagnation pressure and temperature decrease smoothly nevertheless relative flow parameters and Mach number keep their constant values. -Axisymmetric replaceable contoured nozzles are fitted to the flange of a settling chamber.

Kentland Experimental Aerial Systems (KEAS) Laboratory

The Kentland Experimental Aerial Systems (KEAS) Laboratory is located at Virginia Tech's Kentland Farm agricultural research facility, which includes about 1800 acres of university-owned farmland in a sparsely populated area southwest of the main campus. The 300 ft by 70 ft asphalt airstrip located at the center of the Kentland Farm is routinely used to support small unmanned aerial vehicle (UAV) flight operations. The airfield includes a state-of-the-art weather station to log meteorological data. A wireless network covering the area provides direct internet access. The adjacent UAV hangar provides nearly 2000 sq ft of workspace to support research, education, and outreach. The KEAS Lab was developed with support from the: College of Agriculture and Life Sciences Department of Plant Pathology, Physiology, and Weed Science College of Engineering Department of Aerospace and Ocean Engineering Department of Mechanical Engineering Institute for Critical Technology and Applied Science Office of the Vice President for Research Virginia Center for Autonomous Systems The KEAS Lab's primary purpose is to enable research collaborations involving UAVs among university faculty. However, the facility is available to others in the university community who have a research, educational, or outreach related need.

Low Speed Cascade Wind Tunnel

The Low Speed Compressor Cascade Wind Tunnel was designed to simulate conditions found near the tips of fan blades in high bypass ratio aircraft engines. Coincidentally it is also a fairly good representation of flow near the blade tips of a marine propulsion pump. It is sited in the basement of Randolph hall. The cascade consists 8 cantilevered GE rotor B section blades mounted with an adjustable tip gap. The blades are fabricated from aluminum and have a total chord of 10" and an effective span of 10". The blades are instrumented with mean surface pressure taps, and a microphone array for unsteady surface pressure measurement. The cascade configuration has a rectangular cross section of 65" by 10". The blade spacing is 9.29", and the stagger angle of the cascade is 56.93 degrees. The inlet angle of the cascade is 65.1 degrees. The centrifugal fan powering the facility produces a free steam velocity of about 25m/s resulting in a chord Reynolds number of close to 400,000. Instrumentation regularly used with the facility includes a two-axis computerized traverse, single and 3-component hot-wire anemometry, a 3-component fiber-optic LDV system, and instrumentation to sense the instantaneous position and speed of the belt. Work is being conducted on this facility by research groups under the direction of Dr. William Devenport and Dr. Roger Simpson. Recent sponsors include the Office of Naval Research and NASA Langley.

Nonlinear Sytems Laboratory (NSL)

The Nonlinear Systems Laboratory (NSL) in the Aerospace and Ocean Engineering department at Virginia Tech provides a facility for research and instruction in dynamics and control of nonlinear systems. Founded by Dr. Craig Woolsey and Dr. Naira Hovakimyan in 2005, the NSL is now co-directed by Dr. Cornel Sultan, Dr. Mazen Farhood, and Dr. Woolsey. The NSL is a Core Laboratory in the Virginia Center for Autonomous Systems (VaCAS).

Open Jet Wind Tunnel

The open jet wind tunnel was designed in the Fall of 2008 by members of the Aerospace & Ocean Engineering faculty and constructed in 2009 in the AOE machine shop. This research quality facility main purpose is to serve as an educational tool for undergraduate instruction. The open-jet wind tunnel is a blower type, open circuit facility shown in Figure 1. A steel frame at the base of the facility provides stability while the combination of aluminum composite panels and extruded aluminum frame results in a light weight yet strong structure. The tunnel is powered by a 30hp BC-SW Size 365 Twin City centrifugal fan capable of up to 15m3/s. The fan discharges into a 6o, 4m-long diffuser. The flow is then directed into a 1.47m-high by 1.78m-wide settling chamber. A combination of 0.01m-cell size, 0.09m long honeycomb followed by three turbulence reduction screens (made of 0.3mm-diameter fiberglass screen with a 55% open area ratio) ensure a low turbulence and uniform flow. The flow then discharges in the atmosphere through a 5.5:1 contraction nozzle based on a 5th degree polynomial profile. Flow speed is controlled by an AF-600 General Electric variable frequency drive. At a maximum fan speed of 1180 RPM, the flow exits the 5.5:1 contraction at 30m/s. The flow velocity is measured using static pressure taps located at the exit of the settling chamber. A manometer mounted on the side of the tunnel measures the difference between the settling chamber static pressure and the atmospheric. To minimize the impact of the flow on the lab environment, the tunnel is equipped with a jet catcher located 1.2m downstream of the contraction exit (as seen in Figure 2). The main purpose of the jet catcher is to deflect and defuse the stream of air. The jet catcher is made of an extruded aluminum frame with composite panels. Two fiberglass high-loss screens inside the catcher deflect the flow towards the ground and ceiling. Further high-loss screens located at the top and bottom of the jet catcher reduce the flow velocity before it enters the room. For model mounting, the tunnel is also equipped with an adjustable support frame (show in Figure 2). The frame is built out of extruded aluminum beams. The various slots on these beams provide great flexibility for positioning models.

Supersonic Wind Tunnel

The Virginia Tech 23 x 23 cm supersonic/transonic wind tunnel was designed and originally constructed at the NASA Langley Research Center. In 1958, the tunnel was purchased by Virginia Tech and put into operation in 1963. During recent years, several modifications were introduced into the air pumping, tunnel control, and instrumentation equipment which increased the capabilities of the facility. The air pumping system consists of an Ingersoll-Rand Type 4-HHE-4 4-stage reciprocating air compressor driven by a 500 hp, 480V Marathon Electric Co. motor. The compressor can pump the storage system up to 51 atm. A drying and filtering system is provided which includes both drying by cooling and drying by absorption. Air storage system consists of two tanks with a total volume of 23 m. Tunnel control system includes quick opening butterfly valve and a hydraulically actuated pressure regulating 30.5 cm diameter valve. The settling chamber contains a perforated transition cone, several damping screens, and probes measuring stagnation pressure and temperature. The nozzle chamber is interchangeable with two-dimensional contoured nozzle blocks made of steel. The tunnel is equipped with three complete nozzle chambers which presently are fitted with the nozzles for the Mach numbers 2.4, 3.0, and 4.0. The working section of the tunnel is equipped with a remotely controlled model support which allows one to vary the position of a model in the vertical plane. An arrangement for side wall model mounting is also available. An extractable mechanism can be provided for supporting the model during the starting and stopping of the flow. Due to large doors containing the windows in the nozzle and working sections a very good access to the model is ensured. Instrumentation A 30 cm Schlieren apparatus uses two parabolic mirrors and air cooled high pressure mercury lamp. Shadowgraph pictures can be taken either with a direct-shadowgraph system or with a focused shadowgraph arrangement. A 1 microsecond spark source is used for this purpose. Interferograms may be taken with a laser-based single plate interferometer system and a CCD camera. To record flow phenomena of very rapid action and short time duration, the Hycam high speed motion picture camera can be used. The camera can be optically coupled with either Schlieren or shadowgraph apparatus. Operating speed limits are from 1,000 to 45,000 pictures per second. A six-component force and moment balance is also available. The main pressure measuring system includes a PSI Model 780B electronically scanned pressure system. The system is IBM PC computer controlled and presently can handle 32 pressure inputs (0 to 1 atm) simultaneously but, if a need arises, it can be expanded up to 512 pressure inputs. Pressure data rate is up to 20,000 measurements per second and the accuracy is 0.1% of span. In addition to the electronically scanned pressure system, there are two Scanivalve systems available, each allowing to record up to 48 pressures (0-3 atm) during a run of a few seconds duration. Temperature and heat transfer measurements can be made using an automatic multipoint thermocouple reference system and high-speed potentiometric recorders. Data acquisition is all IBM PC based using modern software such as LabView.

Towing Basin

Modeling ship resistance is done by towing a model in a towing basin. The basin, located in the basement of Norris Hall is made of reinforced concrete painted with a chemical and moisture resistant enamel. The width of the basin is 6 feet and the maximum water depth is 4 feet. The overall length of the basin is 98 feet but the first 4 feet and the last 24 feet are used for braking the carriage. The usable test length is then approximately 70 feet. There are two glass walled observation pits along the side of the tank, one located approximately in the middle of the test region and the other pit located at the starting end. The observation pit at the starting end is intended for use in the study of wave reflection and absorption. The carriage and rails were designed and constructed by the firm of Kempf and Remmers of Hamburg, Germany and were shipped in sub-assemblies to Virginia Tech. The allowable tolerance on rail height was 0.1mm. Wedges were used to give final straight alignment of each rail. The allowable tolerance on alignment was 0.2mm. Final alignment was done optically. After final adjustments in height were made, the space between the bearing plates and the bottom of the rail was filled with concrete. A 400 V DC motor drives the carriage through a gear reduction box. The DC power is supplied from a 220 V AC motor-generator set. A maximum speed of the carriage of 3.0 meters per second can be obtained. The carriage braking is done automatically using trips installed at both ends. An emergency brake button is also on the console. The brake is of the magnetic clutch type and brakes the DC motor directly. The brake is applied if power to the carriage is interrupted. Braking deceleration is 0.7 meter per second per second. Ocean Engineering undergraduate students perform two experiments in the basin. They test the resistance of both a surface ship and a submarine.

Transonic Cascade Wind Tunnel

The Virginia Tech Transonic Cascade Wind Tunnel is a blow down transonic facility capable of a twenty second run time. An overall layout is given in Figure X, and a photo is shown in Figure Y. The air supply is pressurized by a four-stage Ingersoll-Rand compressor and stored in large outdoor tanks. The maximum tank pressure used for transonic tests is about 1725 kPa (250 psig). A representative test section for gas turbine cascade testing is given in Fig. Y. Test sections for other types of testing such as a steam turbine cascade and compressor cascades have been used in this facility. During a run, the upstream total pressure is held constant by varying the opening of a butterfly valve controlled by a computerized feedback circuit. There is also a safety valve upstream of the control valve to start and stop the tunnel. The test section area is 37.3 cm high, and is designed for blades with an outlet angle of approximately 70 degrees. The blade isentropic exit Mach number is varied by changing the upstream total pressure; the usual range for exit Mach number is 0.7 to 1.35. The throat Reynolds number for typical tests is 340,000. Figure Z is a diagram of the test section. The tunnel mean flow is left to right on the figure, and is turned through 68 degrees by the blade passages, which act as the tunnel throat. Upstream of the blades, the bundle of three shock shapers protrudes from the test section top block; the shocks propagate down from the shaper exit to the bottom of the test section. The high-response total pressure probe for downstream surveys is also shown on the figure, pointing into the cascade exit flow. The probe moves up and down in line with wall static pressure taps. No tailboard is used downstream of the cascade, which means that a free shear layer forms between the exit plane of the blades and the test section back wall. Note also the upstream total pressure probe, which is fixed at mid-pitch of the Lower passage. Instrumentation A 30 cm Schlieren apparatus uses two parabolic mirrors and air cooled high pressure mercury lamp. Shadowgraph pictures can be taken either with a direct-shadowgraph system or with a focused shadowgraph arrangement. A 1 microsecond spark source is used for this purpose. Interferograms may be taken with a laser-based single plate interferometer system and a CCD camera. To record flow phenomena of very rapid action and short time duration, the Hycam high speed motion picture camera can be used. The camera can be optically coupled with either Schlieren or shadowgraph apparatus. Operating speed limits are from 1,000 to 45,000 pictures per second. A six-component force and moment balance is also available. The main pressure measuring system includes a PSI Model 780B electronically scanned pressure system. The system is IBM PC computer controlled and presently can handle 32 pressure inputs (0 to 1 atm) simultaneously but, if a need arises, it can be expanded up to 512 pressure inputs. Pressure data rate is up to 20,000 measurements per second and the accuracy is 0.1% of span. In addition to the electronically scanned pressure system, there are two Scanivalve systems available, each allowing to record up to 48 pressures (0-3 atm) during a run of a few seconds duration. Temperature and heat transfer measurements can be made using an automatic multipoint thermocouple reference system and high-speed potentiometric recorders. Data acquisition is all IBM PC based using modern software such as LabView.

Virginia Tech Stability Wind Tunnel

The Stability Wind Tunnel is operated by the Aerospace and Ocean Engineering Department. With a 1.83m-by-1.83m test-section, it is one of the largest university operated wind tunnels in the United States with maximum speeds of 80m/s (corresponding to a Reynolds number of 5,000,000 per meter). In addition to its size, the flow quality is remarkable making it a prime research facility. The aerodynamic capabilities were recently increased by the addition of a removable anechoic test-section allowing for full-scale aero-acoustic testing. Since May, 2004, the facility has been under the direction of Dr. William Devenport, and currently employs one full time test engineer and several part time student employees. Detailed information about the Virginia Tech Stability Wind Tunnel can be found in the sections below. You can download the Stability Tunnel brochure for a summary of key features. The Virginia Tech Six Foot Stability Wind Tunnel was originally built at the NACA Langley Aeronautical Laboratory in 1940. It was designed to determine dynamic stability derivatives using a fixed model position, and was known at Langley as the "stability tunnel." Many of the NACA reports containing stability derivative data describe wind tunnel tests conducted in this tunnel. The wind tunnel was acquired by VPI in 1958, and the tunnel was erected in 1959 in a specially designed wing of Randolph Hall. Calibration of the tunnel was carried out from 1959 to 1961, when it became operational again. In 1994 the fan motor was completely overhauled and the windings reinsulated. In 1996 new fan blades were installed increasing the overall tunnel efficiency.

DEGREES OFFERED

MS Degree

Offered In (Virtual, Blacksburg)

TOEFL

iBT: (90.0)

GRE

General Test: Verbal, Quantitative, Analytical

Master of Science Requirements: Thesis and (Non-Thesis) 1. A minimum of 30 credit hours is required. • For thesis students, up to 9 credit hours may be allotted for Research and Thesis (AOE 5994). 2. A minimum of 15 credit hours (18 for non-thesis) of graded course work numbered 5000 and higher must be included in the Plan of Study. These credit hours do not include the AOE Seminar (AOE 5944), Research and Thesis (AOE 5994) hours, or Project and Report (AOE 5904) hours. 3. A maximum of 6 credit hours of 5974 and 5984 is allowed. 4. A maximum of 6 credit hours of approved 4000 level course work is allowed. 5. Up to 50% of the courses on the Plan of Study may be transferred from a graduate program at another institution, subject to the approval of the Advisory Committee. Substitution of a transferred course for a specific required course is subject to the approval of the Graduate Program Director or a designee, usually the responsible instructor. Each transferred course must have a grade of B (3.0/4.0) or better. 6. Breadth Requirement: All MS AE students are required to take at least one course each in three out of the four disciplinary areas identified below. Fluid Mechanics • AOE 5104, Advanced Aero and Hydrodynamics; • AOE 5114, High Speed Aerodynamics; • AOE 5124, Aero and Hydroacoustics; • AOE 5135, Vehicle Propulsion; • AOE 5144, Boundary Layer Theory. Dynamics and Control • AOE 5204, Vehicle Dynamics and Control; • AOE 5744, Linear Systems Theory; • AOE 5754, Applied Linear Systems; • AOE 5774, Nonlinear Systems Theory; • AOE 5234, Orbital Mechanics. Structures and Materials • AOE 5024, Vehicle Structures; • AOE 5034, Mechanical and Structural Dynamics; • AOE 5054, Stability of Structures; • AOE 5064, Structural Optimization. Applied Physics • AOE 5174, Introduction to Plasma Science; • AOE 5xxx, Spacecraft Propulsion; • AOE 5654, Introduction to Space Science I: The Solar Wind and Magnetosphere; • AOE 5664, Upper Atmosphere and Ionosphere; • ECE 5194, Remote Sensing: Principles and Techniques. 7. Math Requirement: All MS Students are required to take at least one course (of three credits or more) focused on graduate-level mathematics, statistics, or numerical methods. A sample list of courses satisfying this requirement is given in Appendix B. The MS Advisory Committee can approve other courses that have majority of their learning outcomes on advanced mathematics, statistics, or numerical methods. APPENDIX B Sample of approved courses focused on Mathematics, Statistics, or Numerical Methods: 1. AOE 5404, Applied Numerical Methods; 2. AOE 5434G, Advanced Introduction to Computational Fluid Dynamics; 3. AOE 5734, Convex Optimization; 4. AOE 6145, Computational Fluid Dynamics; 5. AOE 6174, Computational Plasma Dynamics; 6. AOE 6314, Advanced Dynamics; 7. AOE 6444, Verification and Validation in Scientific Computing; 8. ESM 5734, Introduction to the Finite Element Method; 9. ESM 5744, Energy and Variational Methods in Applied Mechanics; 10. ESM 6714, Applied Tensor Analysis; 11. ESM 6734, Finite Element Analysis; 12. MATH 5225, Real Analysis 13. MATH 5235, Complex Analysis; 14. MATH 5424, Numerical Linear Algebra; 15. MATH 5425, Applied Partial Differential Equations; 16. MATH 5465, Numerical Analysis; 17. MATH 5474, Finite Difference Methods for Partial Differential Equations; 18. MATH 5484, Finite Element Methods for Partial Differential Equations; 19. STAT 5044, Regression and Analysis of Variance; 20. STAT 5104, Probability and Distribution Theory; 21. STAT 5434, Applied Stochastic Processes; 22. STAT 5444, Bayesian Statistics; 23. STAT 5525, Data Analytics; 24. STAT 5616, Statistics in Research; 25. STAT 5664, Applied Statistical Time Series Analysis for Research Scientists. 8. Non-thesis MS AE students must take at least two additional graduate courses in AOE. See Appendix C for a list of courses to take for a specialization in (i) Fluid Mechanics, (ii) Dynamics, Controls, and Estimation, (iii) Structures and Materials, and (iv) Space Engineering. APPENDIX C Sample List of Courses for MS AE Specializations Fluid Mechanics This area is concerned with the determination of forces and moments caused by the motion of an aerospace or ocean vehicle through a liquid or gaseous medium, and with the nature of the flow field around the vehicle and in its wake. This determination ranges from very low subsonic speeds through the speed of sound (transonic) to supersonic and hypersonic speeds. Both inviscid and viscous flow phenomena are significant. In addition, the study of internal flow fields associated with propulsion is a subset of this area. Sample course list: • AOE 5024, Vehicle Structures • AOE 5104, Advanced Aero and Hydrodynamics • AOE 5114, High Speed Aerodynamics • AOE 5124, Aero and Hydroacoustics • AOE 5135, Vehicle Propulsion • AOE 5144, Boundary Layer Theory • AOE 5204, Vehicle Dynamics and Control • AOE 5404, Applied Numerical Methods • AOE 5434G, Advanced Introduction to Computational Fluid Dynamics Dynamics, Control and Estimation The area of dynamics involves dynamic modeling and analysis for space, atmospheric, and ocean vehicles. The area of control and estimation involves the development and application of methods for vehicle guidance, navigation, and control. Sample course list: • AOE 5024, Vehicle Structures • AOE 5104, Advanced Aero and Hydrodynamics • AOE 5204, Vehicle Dynamics and Control • AOE 5744, Linear Systems Theory • AOE 5754, Applied Linear Systems • AOE 5774, Nonlinear Systems Theory • AOE 5234, Orbital Mechanics • AOE 5404, Applied Numerical Methods • AOE 5734, Convex Optimization Structures and Materials This area involves development and application of methods for design and evaluation of aerospace and ocean structures. Principal subjects of study are structural analysis, computational mechanics, structural optimization, composite structures, smart structures, 31 structural health monitoring, material science, machine learning, and multi-disciplinary analysis and optimization. Sample course list: • AOE 5024, Vehicle Structures • AOE 5034, Mechanical and Structural Dynamics • AOE 5054, Stability of Structures • AOE 5064, Structural Optimization • AOE 5104, Advanced Aero and Hydrodynamics • AOE 5204, Vehicle Dynamics and Control • AOE 5404, Applied Numerical Methods • ESM 5734, Introduction to the Finite Element Method • ESM 5744, Energy and Variational Methods in Applied Mechanics Space Engineering This area is concerned with the multidisciplinary application of Aerospace, Electrical, Mechanical, and Systems Engineering (among others) to the development of advanced space instrumentation, vehicles, constellations, and space exploration systems. Sample course list: • AOE 5024, Vehicle Structures • AOE 5104, Advanced Aero and Hydrodynamics • AOE 5174, Introduction to Plasma Science • AOE 5204, Vehicle Dynamics and Control • AOE 5234, Orbital Mechanics • AOE 5404, Applied Numerical Methods • AOE 5654, Introduction to Space Science I: The Solar Wind and Magnetosphere • AOE 5664, Upper Atmosphere and Ionosphere • AOE 5xxx, Spacecraft Propulsion

MEng Degree

Offered In (Virtual, Blacksburg)

GRE

General Test: Verbal, Quantitative, Analytical

TOEFL

Paper: (90.0)

iBT: (90.0)

Master of Engineering Requirements 1. The M. Eng. degree is a non-thesis degree. However, each candidate is required to prepare a paper, the subject and outline of which must be approved by the student's Advisor and Advisory Committee. The purpose of this paper is to develop and demonstrate the student's ability to plan and carry out projects or problems relating to engineering practice. This project is carried out under the auspices of a special project (AOE 5904, Project and Report). 2. A minimum of 30 credit hours is required, of which 3-6 credit hours must be allotted for AOE 5904. 3. A minimum of 18 credit hours (including 5974 and 5984) of graded course work numbered 5000 and higher must be included in the Plan of Study. 4. A maximum of 6 credit hours of approved 4000 level course work is allowed. 5. A maximum of 6 credit hours of 5974 and 5984 is allowed. 6. Up to 50% of the courses on the Plan of Study may be transferred and are subject to approval of the Advisory Committee. Substitution of a transferred course for a specific required course is subject to the approval of the Graduate Program Director or a designee, usually the responsible instructor. Each transferred course must have a grade of B (3.0/4.0) or better. 7. All M. Eng. candidates are required to take: • AOE 5404, Applied Numerical Methods; • AOE 5104, Advanced Aero-Hydrodynamics; • AOE 5024, Vehicle Structures; 15 • AOE 5204, Vehicle Dynamics and Control; and • One additional AOE graduate course. If a student has previously taken, while an undergraduate or student elsewhere, any of the specific required AOE courses above or equivalent, that course must be replaced with another AOE graduate course acceptable to the Advisory Committee. A student will not be allowed to repeat a course from Virginia Tech or one that is equivalent from another institution for a grade. 8. The project described in requirement (1) may be carried out in conjunction with other students in the same program (e.g., a design project with several students of varied interests).

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

GRE

General Test: Verbal, Quantitative, Analytical

Doctor of Philosophy Requirements (beyond B.S.) 1. A minimum of 90 credit hours beyond the B.S. degree are required. 2. A minimum of 30 hours of Research and Dissertation (AOE 7994) must be included on the Plan of Study. All Ph.D. students must register for dissertation credit in accordance with the amount of time devoted to dissertation research. For example, a full-time research load would be 12 credit hours of dissertation credit, and would require a minimum of 40 hours per week of work devoted to research. 3. A minimum of 30 credit hours of graded course work numbered 5000 or above must be included. Up to 6 credit hours of 4000-level course work is allowed if approved by the PhD Advisory Committee. 4. A maximum of 9 credit hours of Independent Study (5974) and Special Study (5984) may be included. 5. A minimum of two consecutive semesters of full-time enrollment must be spent in residence at the Blacksburg campus (or with prior approval at some designated off-campus graduate center). At least 12 credit hours of course work (not including AOE 7994) must be earned while in residence. 6. Up to 15 credits of course work on the Plan of Study may be transferred from another university and is subject to the approval of the PhD Advisory Committee. Each transferred course must, (i) have a grade of B (3.0/4.0) or better, (ii) have been earned while in good standing in graduate status, and (iii) have been graduate courses at the institution where the student took the courses. Courses that are double-counted for both an undergraduate and graduate degree for students in Virginia Tech’s UG/G Program are subject to the grade requirements for transfer courses. 7. All Ph.D. candidates are required to have taken or be enrolled in all of the courses on the Plan of Study by the semester in which the student presents the PhD Pre-defense. 8. AOE Course Requirement: All PhD candidates are required to take at least six AOE courses. All graduate courses with an AOE number are considered AOE courses. Any graduate course taught by an AOE faculty will also be considered an AOE course for this requirement. All courses on the list of Breadth courses (see below) can count towards both the AOE Course Requirement and the Breadth Requirement. a. Students may use transfer courses to satisfy this requirement. Substitution of a transferred course for a specific AOE course from the graduate course catalogue is subject to the approval of the Graduate Program Director on the recommendation of the responsible instructor. The student may request that a transfer course not listed in the graduate course catalogue be used to satisfy an AOE course requirement if the course is typically taught in an Aerospace or Ocean Engineering program. The Graduate Program Director will approve it on the recommendation of the PhD Advisory Committee. 9. Breadth Requirement: All PhD candidates are required to take at least one course each in three out of the four disciplinary areas identified below. a. The student must have taken or be enrolled in at least two of the three disciplinary breadth courses by the semester in which the student takes the PhD Preliminary Examination. b. Students may use transfer courses to satisfy this requirement. Substitution of a transferred course for a specific course listed below is subject to the approval of the Graduate Program Director on the recommendation of the responsible instructor. The student may request that a transfer course not listed below be used to satisfy a breadth requirement if the course is transferred from an Aerospace or Ocean Engineering program and primarily covers the breadth area. The Graduate Program Director will approve it on the recommendation of the AOE Graduate Committee. Fluid Mechanics Sample course list: i. AOE 5104, Advanced Aero and Hydrodynamics; ii. AOE 5114, High Speed Aerodynamics; iii. AOE 5124, Aero and Hydroacoustics; iv. AOE 5135, Vehicle Propulsion; v. AOE 5144, Boundary Layer Theory; vi. AOE 5304, Advanced Naval Architecture. Dynamics and Control Sample course list: i. AOE 5204, Vehicle Dynamics and Control; ii. AOE 5744, Linear Systems Theory; iii. AOE 5754, Applied Linear Systems; iv. AOE 5774, Nonlinear Systems Theory; v. AOE 5234, Orbital Mechanics; vi. AOE 5334, Advanced Ship Dynamics; vii. AOE 5444G, Advanced Dynamics of High-Speed Craft. Structures and Materials Sample course list: i. AOE 5024, Vehicle Structures; ii. AOE 5034, Mechanical and Structural Dynamics; iii. AOE 5054, Stability of Structures; iv. AOE 5064, Structural Optimization; v. AOE 5074, Advanced Ship Structural Analysis. Applied Physics Sample course list: i. AOE 5174, Introduction to Plasma Science; ii. AOE 5xxx, Spacecraft Propulsion; iii. AOE 5654, Introduction to Space Science I: The Solar Wind and Magnetosphere; iv. AOE 5664, Upper Atmosphere and Ionosphere; v. ECE 5194, Remote Sensing: Principles and Techniques. 10. Math Requirement: All PhD candidates are required to take at least one course (of three credits or more) focused on graduate-level mathematics, statistics, or numerical methods. A sample list of courses satisfying this requirement is given in Appendix B. The PhD Advisory Committee can approve other courses (including transfer courses) that have majority of their learning outcomes on advanced mathematics, statistics, or numerical methods.

GRADUATE COURSES (AOE)

AOE 5024:

Vehicle Structures

Exact and approximate methods for analysis and design of aerospace and marine structures. Stresses, strains, constitutive equations, boundary value problems, and two-dimensional elasticity; torsion; variational methods; virtual work and energy principles; structural mechanics theorems; traditional approximate methods; and laminated plates.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5034 (ESM 5304):

Mechanical and Structural Vibrations

Free and forced vibrations of single-degree-of-freedom systems, multi-degree-of-freedom systems, continuous systems including strings, rods, bars, and beams. Natural frequencies and modes. Rigid Body modes. Proportional and nonproportional damping. Response to harmonic, periodic, and nonperiodic excitations. Solutions by modal analysis, direct integration and Fourier Series. Approximate methods including assumed modes and the Rayleigh-Ritz method. Advanced topics chosen by instructor.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5054 (ESM 5454):

Elastic Stability

Stability of elastic structural components under conservative loads; precise definitions of stability; energy approaches; Rayleigh-Ritz and Galerkin methods; and applications to column, arches, plates, and shells.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 3124 (UG) OR CEE 3404 (UG)

Corequisite(s):

AOE 5064 (ESM 5064):

Structural Optimization

Structural optimization via calculus of variations. Application of techniques of mathematical programming to optimize trusses, beams, frames, columns, and other structures. Sensitivity calculation of structural response. Approximation techniques and dual and optimality criteria methods. A background in optimization is necessary.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5074:

Advanced Ship Structural Analysis

Analysis of plate bending, buckling, and ultimate strength using computational tools and methods. Calculation of elastic buckling of stiffened panels. Eigenvalue methods for buckling and vibration. Incremental plastic collapse; other progressive collapse. Ultimate strength of large structural modules due to combined loads. Introductory level finite element analysis. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5084:

Submarine Design

Application of engineering disciplines to the design of a steam turbine propelled nuclear submarine. The disciplines involved are fluid mechanics, solid state mechanics, structures, machine design, thermodynamics and heat transfer.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5104:

Advanced Aero and Hydrodynamics

Vector analysis concepts; fluid stress and strain, kinematics of fluid flows including vorticity; dynamics of inviscid incompressible flow; and potential flow theory with applications to lifting and non-lifting bodies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5114:

High Speed Aerodynamics

Aerothermodynamic phenomena and shock waves. Linearized subsonic and supersonic flow past planar surfaces and bodies of revolution.

Theory of transonic aerodynamics including study of mixed flow. Similarity laws. Mathematical representation of inviscid compressible flows in equilibrium. Potential function, stream function, rotationality and geometrical considerations. Method of characteristics applied to hyperbolic flow fields. Discussion of techniques for solution of elliptic flow fields. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5124:

Aero and Hydroacoustics

Aeroacoustics for students familiar with the foundations of fluid dynamics. Fundamental theories of aeroacoustics, including Lighthill's analogy, the Ffowes-Williams Hawkings equation and Goldstein's equation. Mathematical methods needed to and apply these theories, including correlation and spectral methods for turbulent flows. Applications include the prediction of leading and trailing edge noise are taught. Relevant experimental methods, including facilities, corrections, instrumentation, signal processing and phased microphone arrays.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5104

Corequisite(s):

AOE 5144:

Boundary Layer Theory and Heat Transfer

Conservation equations and constitutive relations, exact Navier Stokes solutions; boundary layer approximation and special solutions; approximate methods; compressibility and heat and mass transfer effects; and numerical methods and simple turbulence models.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5104

Corequisite(s):

AOE 5154:

Data Analysis in Fluid Dynamics

Data analysis techniques and their role in fluid dynamics research. Fundamental tools for statistical analysis of random processes. Ways to obtain physical meaning from fluid dynamics data. Techniques for single-point statistics and correlation-based, multi-point statistics of data fields. Hypothesis-driven study of complex flow phenomena. Analysis of unsteady and turbulent flow emphasized. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5164:

Fluid-Structure Interaction

Review of essential elements of elastic vibration and basic fluid mechanics; hydroelasticity based on potential flow theory; acoustic-structure interaction; dynamic aeroelasticity of airfoils; analytical solution of selected 1- and 2-D model problems; overview of computational models and methods for nonlinear fluid-structure interaction problems (e.g., partitioned and monolithic procedures, arbitrary Lagrangian-Eulerian, immersed/embedded boundary, interface tracking). Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5174 (ECE 5174):

Introduction to Plasma Science

Underlying physical processes and basic computational techniques for laboratory, space, and technological plasma environments including single particle motion, fluid and kinetic theory of plasmas, plasma waves and instabilities, diffusion and resistivity, and nonlinear effects. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5184 (ME 5184):

High Speed Propulsion

Analysis of high-speed air breathing propulsion concepts for hypersonic flight. Aerodynamic inlet design and flow path integration. Cycle analyses, flight performance, and design limitations given a set of design requirements. Aerothermodynamic analysis of ramjets, scramjets, and detonation wave engines. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5204:

Vehicle Dynamics and Control

Relevant rigid body kinematics and dynamics fundamentals for vehicles such as aircraft, spacecraft, and ships. Provides foundation for advanced courses and research on dynamics and control of vehicles. Review of particle motion and application to aircraft performance and satellite orbital mechanics. Rigorous modeling of rotational and translational motion of rigid bodies. Linearization of equations of motion for stability analysis, modal analysis, control system synthesis, with introduction to classical control system concepts. Sensors and actuators commonly used on vehicles. Specific examples from aircraft, missiles, spacecraft, rockets, ships, and submersibles. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5224G:

Advanced Atmospheric and Ocean Vehicle Model Identification

Atmospheric and ocean vehicle dynamic modeling from experimental data including: experiment design; model structure determination; parameter and state estimation; and data analysis methods. Regression and maximum likelihood approaches. Time and frequency domain formulations. Applications to airplanes, rotorcraft, surface vessels, and undersea vehicles. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5234:

Orbital Mechanics

Lagranges equations of motion, two-body problem, conic sections, Keplers laws, orbit determination. Multi-body problems and integrals of motion. Fundamentals of perturbation theory, variation of parameters, and Lagranges planetary equations. Regularization and alternative formulations of equations of motion.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5304:

Advanced Naval Architecture

Engineering analysis methods for evaluating the hydrostatic, hydrodynamic, and structural characteristics of surface ships and submarines. Methods employed in ship design include analytical, statistical, and experimental approaches. Both hull and propulsor analysis techniques are covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5314:

Naval and Marine Engineering Systems Design

Concepts, theory, and methods for the engineering, design, integration, and assessment of ship mechanical, electrical, fluid and naval systems. Description and functional physics of system components, system architecture, and the modeling of system effectiveness for multidisciplinary and multi-objective design optimization. System integration, interfaces, and analyses considering ship arrangements, signatures, system deactivation diagrams and vulnerability, reliability, maintenance, system power, shock and weapons effects and damage control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5324

Corequisite(s):

AOE 5315:

Naval Ship Design

Capstone naval ship design concept exploration including the study and application of the system engineering process to the simultaneous development of naval ship requirements, selection of ship technologies, and definition of a baseline naval ship design. Hullform, machinery, ship synthesis and balance, metrics (including Overall Measure of Effectiveness, technology risk, and cost) and design optimization in the context of a naval ship design project.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5304, AOE 5314, AOE 5334, AOE 5074

Corequisite(s):

AOE 5316:

Naval Ship Design

Development of a naval ship baseline design including hullform, combat systems, topside arrangements, internal subdivision and tankage, power and propulsion, auxiliary machinery, general arrangements, machinery arrangements, human systems, structural design, assessments of intact and damage stability, shock and survivability, weights, space, seakeeping, cost, risk, and overall balance and feasibility.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5315

Corequisite(s):

AOE 5324:

Principles of Naval Engineering with Applications

Basic functional principles and theory for naval engineering systems and system engineering processes. Particular emphasis is given to: naval missions; combat system performance including radar; underwater acoustics and sonar; ballistics; weapon propulsion and architecture; weapons effects; ship survivability including underwater explosion and shock waves; surface ship and submarine hydrostatics, balance and feasibility analysis; and total ship integration. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5334:

Advanced Ship Dynamics

Derivation of the equations of motion of a ship; waves and wave forces on structures; description of wave statistics and spectral representation in a given sea state; ship response in regular waves; ship response in random waves. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5354 (ISE 5314):

Industrial Robotics

Design, programming principles, and performance evaluation methods for robotic systems employed for both classical and advanced manufacturing applications. Common design choices for industrial robots, underlying dynamical models, and their performance are analyzed. Position and attitude representation techniques, direct and inverse kinematic problems, singularity analysis through a study of the Jacobian matrix, and dynamical modeling of industrial robots are discussed. Both classical and advanced control techniques are synthesized to guarantee high performance both in nominal and off-nominal conditions. Elements of computer vision for industrial robotics are presented. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5404:

Numerical Methods for Aerospace and Ocean Engineering

Numerical methods for solving differential equations and optimization problems in aerospace and ocean engineering. Iterative methods for solving systems of linear and nonlinear equations. Rate of convergence. Matrix factorization techniques. Solution of least squares problems. Numerical methods for multivariate unconstrained and constrained optimization. Finite difference method for ordinary and (elliptic, parabolic, and hyperbolic) partial differential equations. Order-of-accuracy and numerical stability analysis. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5434G (ME 5434):

Advanced Introduction to Computational Fluid Dynamics

Euler and Navier-Stokes equations governing the flow of gas and liquids. Mathematical character of partial differential equations. Discretization approaches with a focus on the finite difference method. Explicit and implicit solution techniques and their numerical stability. Introduction to verification, validation, and uncertainty quantification for computational fluid dynamics predictions. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5444G:

Advance Dynamics of High Speed Marine Craft

Study of the dynamics of high-speed craft, including surface effects ships, hydrofoil vessels, semi-displacement monohulls and catamarans, and planning vessels. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5604:

Modeling Composites Damage

Algorithms, techniques and tools applied in multiscale modeling of damage and failure in composite materials. Continuum level models, mesoscale models, and atomistic models. Analytic and computational techniques for capturing damage effects and conducting length scale transitions. Homogenization techniques, multiple scale expansion, finite element analysis, continuum damage models, cohesive zone models, dislocation dynamics, particle methods, and molecular statics and dynamics. Role of mesh-independent and meshless methods in modeling damage evolution. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5614:

Modeling Multifunct Composites

Algorithms, techniques and tools applied in multiscale modeling of multifunctional composite materials. Continuum mechanics mathematical models for mechanical, thermal, and electromagnetic behaviors and linear and nonlinear couplings between them in active materials. Origins of coupled material response in active materials. Analytic and computational micromechanics to predict macroscale multifunctional composite properties based on active material constituents at the microscale.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5654 (ECE 5164):

Intro to Space Science I

Describes the space environment from the sun to the earths upper atmosphere. Fundamental concepts in space plasma physics will be presented, as needed, throughout the course. Numerous examples of observations and data will be utilized to illustrate the environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment (space weather) on modern technologies such as solid state devices, satellite technology, communication and global navigation systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): ECE 5105

AOE 5664:

Upper Atmosphere and Ionosphere

Fundamental concepts of solar-terrestrial physics; interaction of Earth’s upper atmosphere and space environment with spacecraft; upper atmospheric composition, radiation, photochemistry and energy balance; structure of the upper atmosphere; impacts of transport and dynamics on the upper atmosphere; ionospheric composition, production and loss and its relation to Chapman theory; ionospheric structure; impacts of ionospheric electrodynamics; impacts of geomagnetic storms on the upper atmosphere and ionosphere; radio wave propagation; comparisons to other planets; details of atmospheric and ionosphere instrumentation. Pre: Graduate standing in Engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5734 (ME 5584) (ECE 5734):

Convex Optimization

Recognizing and solving convex optimization problems. Convex sets, functions, and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5744 (ME 5544) (ECE 5744):

Linear Systems Theory

Advanced introduction to the theory of time-varying and time-invariant linear systems represented by state equations; solutions of linear systems, uniform stability and other stability criteria, uniform observability and controllability, state feedback and observers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 (UG) OR ECE 4405 OR ECE 4624 (UG) OR ECE 4634 OR ECE 4634 (UG) OR ECE 4634 OR ME 4504 (UG) OR ME 4504 OR AOE 4004 (UG) OR AOE 4004

Corequisite(s):

AOE 5754 (ME 5554) (ECE 5754):

Applied Linear Systems

Develop an applied understanding of state-space representations for linear time invariant multi-input multi-output dynamic systems in both time domain and frequency domain. Introduction to modern state-space control methods; state feedback and output feedback. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 (UG) OR ECE 4405 OR ECE 4624 (UG) OR ECE 4624 OR ECE 4634 (UG) OR ECE 4634 OR ME 4504 (UG) OR ME 4504 OR AOE 4004 (UG) OR AOE 4004

Corequisite(s):

AOE 5764 (ME 5564) (ECE 5764):

Applied Linear Control

Analysis and design of sampled-data systems, extraction of discrete-time dynamic models from experimental data, and implementation of dynamic compensators on digital processors. In-depth design experience with LQR optimal control and an introduction to Kalman filtering. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5744 OR AOE 5754 OR ME 5554 OR ME 5544 OR ECE 5744 OR ECE 5754

Corequisite(s):

AOE 5774 (ME 5574) (ECE 5774):

Nonlinear Systems Theory

Introduction to the theory of systems of coupled, nonlinear, time-varying ordinary differential equations: existence and uniqueness of solutions; continuous dependence on parameters; stability of equilibria and stability analysis techniques; input-to-state stability; input-output stability; nonlinear design techniques including input-state and input-output feedback linearization, backstepping, and sliding mode control. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5784:

Model-Based Estimation and Kalman Filtering

Modeling of estimation problems including batch and dynamic problems; stochastic linear and nonlinear dynamic system models including Markov process models; batch nonlinear least-squares estimation; linear Kalman filtering and smoothing algorithms for dynamic problems; square-root information filtering and smoothing; nonlinear Kalman filtering, including the extended Kalman filter, the unscented Kalman filter, and particle filters; covariance analysis; filtering applications. Co: 5744 or 5754 or ECE 5744 or ME 5544 or ECE 5754 or ME 5554.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5844:

Wave Mechanics

Linear wave theory including boundary value problems, wave transformation in shallow waters, long waves, and engineering properties of waves. Introduction to nonlinear wave theories. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5894:

Final Examination

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5904:

Project and Report

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Lecture, Online Research
Instruction Type(s): Research, Online Lecture, Online Research
Prerequisite(s):
Corequisite(s):

AOE 5944:

Seminar

Discussion of current research topics in Aerospace and Ocean Engineering by local and visiting scholars. This course cannot be used to fulfill the minimum requirements of 30 hours toward the Masters Degree or 90 hours toward the Ph.D. Degree in Aerospace and Ocean Engineering. May be repeated.

Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5974:

Independent Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

AOE 5984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

AOE 6024:

Aeroelasticity

Discussion of the aeroelastic phenomena including flutter, divergence, control surface effectiveness, and lift redistribution; and introduction to traditional and modern methods of analysis and remedies for aeroelastic problems of flight vehicles.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): AOE 5034, AOE 5104, AOE 5214
Corequisite(s):

AOE 6064:

Reliability-Based Design Optimization

Analyze uncertainties associated with mechanical and structural design. Methods to model various uncertainties in a design using stochastic expansions and other probabilistic analysis tools. Computation of safety index and structural reliability using efficient techniques for implicit functions. Optimize designs under uncertainty.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5064 OR AOE 5734 OR ECE 5734 OR ISE 5406 OR MATH 5485 OR ME 5584

Corequisite(s):

AOE 6114:

Transonic Aerodynamics

Basic features of transonic flows, similarity methods, and hodograph methods. Major emphasis on finite difference procedures including type dependent relaxation procedures for potential flows and time asymptotic Euler solutions. Grid generation methods, inverse design procedures, unsteady flow, wind tunnel/wall interference, and shock wave/boundary layer interactions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 3114 (UG), AOE 4404 (UG), AOE 5144

Corequisite(s):

AOE 6124:

Hypersonic Aerodynamics

Theory of inviscid hypersonic flows; blunt body and Newtonian aerodynamics; nonlinear small disturbance theory; and approximate methods and comparisons with experiment. Viscous hypersonic flow theory; skin friction and heat transfer on blunt and slender bodies; and vorticity, entropy layer, and viscous-inviscid inter-action effects.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5114

Corequisite(s):

AOE 6145:

Computational Fluid Dynamics

Computational methods for incompressible, compressible, and viscous fluid flows. Theoretical and numerical developments for wave equation, heat equation, Poissons equation, and Burgers equation. Applications to inviscid subsonic, transonic, and supersonic flows, viscous boundary layer, Navier Stokes, thin layer equations, and grid generation techniques. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 6154:

Turbulent Shear Flow

Advanced treatment of the physical phenomena of turbulent boundary layers, jets, wakes, and duct flows; coherent structures; entrainment, bursting, vortex dynamics; and unsteady, wall, and freestream turbulence effects.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5144 (UG)

Corequisite(s):

AOE 6174 (ECE 6174):

Computational Plasma Dynamics

Computational techniques for investigating processes in plasmas over a broad range of spatial and temporal scales. Investigation of physical processes including electrodynamics, waves and turbulence, space propulsion, spacecraft environmental effects and various laboratory applications. Computational techniques including full Particle-in-Cell (PIC), hybrid (fluid-electron, PIC ion), magnetohydrodynamics MHD and two-fluid methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5174 OR AOE 5174

Corequisite(s):

AOE 6204:

Adv Vehicle Dynamics & Control

Topics in the dynamics and control of systems including airplanes, helicopters, spacecraft, and structures. Physics and data-based modeling from the control system designers perspective. Structure of the control-oriented equations of motion in relation to robust control design. Bio-inspired design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): AOE 5204
Corequisite(s):

AOE 6234:
Advanced Orbital Mechanics
Canonical dynamics and applications to the two and three body problems. Classical and canonical variation of parameter equations of motion. Forces influencing Earth satellite motion are surveyed. Applications to Earth satellite motion. Additional topics from resonance, stability, periodic motion, numerical integration, and orbit determination.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): AOE 5234
Corequisite(s):

AOE 6254 (ESM 6254):
Turbulence Modeling and Simulation
In-depth study into the modeling and simulation of turbulent flows. Derivation of exact equations describing turbulent flows along with various approaches to turbulent closure. Turbulence modeling via algebraic, RANS, and Reynolds stress models. Turbulence simulation via DNS, LES and hybrid RANS/LES approaches and analysis of results. Turbulence compressibility effects, body forces, boundary conditions, wall functions, sub-grid modeling approaches, turbulence anisotropy and stress invariants, and realizability. Strengths and weaknesses of the different modeling and simulation approaches. Role of numerics in different modeling approaches. Pre: Graduating standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 6314 (ESM 6314):
Advanced Dynamics
Fundamental concepts of analytical mechanics, variational principles, Lagranges equations, rigid-body kinematics and dynamics, Euler parameters, quasi-coordinates, Eulers equations, gyroscopic systems, Hamilton-Jacobi equation, transformation theory, introduction to optimal control theory, advanced concepts in stability theory.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ESM 5314
Corequisite(s):

AOE 6434 (ME 6434):
Computational Fluid Dynamics and Heat Transfer
Overview of numerical methods used in the study of computational fluid dynamics (CFD) and heat transfer. Spatio-temporal finite-difference, finite-volume discretizations, solution of linear systems with direct and iterative methods, algorithms for solving the Navier Stokes and energy equations, and turbulence modeling. Applications to inviscid subsonic, transonic, and supersonic flows and viscous boundary layer. Theory reinforced with hands on programming assignments and the application of commercial CFD packages to select problems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ME 5404, ME 5314, ME 5104
Corequisite(s):

AOE 6444 (ME 6444) (CS 6444):
Verification and Validation in Scientific Computing
Applicable to scientific and engineering models described by partial differential or integral equations. Software engineering, code verification, and the method of manufactured solutions for generating exact solutions. Estimation of numerical approximation errors in scientific computing. Design and execution of experiments for model validation and model accuracy assessment. Propagation of aleatory and epistemic uncertainty through models. Estimation of total prediction uncertainty in scientific computing simulations. Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 6744 (ME 6544) (ECE 6744):
Linear Control Theory
Advanced introduction to the theory of optimal control of time-varying and time-invariant linear systems; Solutions to the linear-quadratic regulator, optimal filtering, and linear-quadratic-gaussian problems; Robustness analysis and techniques to enhance robustness of controllers.
Credit Hour(s): 3
Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5744 OR ECE 5754 OR ME 5544 OR ME 5554 OR AOE 5744 OR AOE 5754
Corequisite(s):

AOE 6774 (ECE 6774) (ISE 6574) (ME 6574):
Adaptive Control Systems
Introduction to the theory and methodology used to design adaptive controllers for uncertain systems, addressing issue such as input constraints, disturbance rejection, partial measurements, and robustness.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)
Corequisite(s):

AOE 6974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

AOE 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

AGRICULTURAL AND APPLIED ECONOMICS

Matthew Holt, Head

Professors: Jeffrey Alwang; Darrell Bosch; Kevin Boyle; George Davis; Michael Ellerbrock; Jason Grant; Matthew Holt; Olga Isengildina Massa; Bradford Mills; Klaus Moeltner; Stephen Stephenson;
Associate Professors: Susan Chen; Catherine Larochelle;
Assistant Professors: Elinor Benami; John Bovay; Zhenshan Chen; Anubhab Gupta; Xi He; Chanita Holmes; Shamar Stewart; Chi Ta; Wei Zhang; Jonathan van Senten;
John B. and Kristi L. Rowsell Professor: Olga Isengildina Massa;
W.G. Wysor Professor of Agriculture: Jason Grant;
Associate Professor of Practice: Dixie Dalton;
Professor of Practice: Jennifer Friedel;

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Our Graduate Program: https://aaec.vt.edu/academics/graduate.html
Explore AAEC's Website: https://aaec.vt.edu/

The Department of Agricultural and Applied Economics (AAEC) offers a strong and growing graduate program that provides exciting study and research opportunities for students and has an outstanding record of graduate student placement. AAEC offers a M.S. in Agricultural and Applied Economics and a Ph.D. in Economics jointly with the Department of Economics. The Master's degree focuses on applied economics. A student may select courses that build upon a broad-based undergraduate economics curriculum or may specialize in a specific field of interest. By their choices among core courses and use of various electives, students may develop specialties in diverse areas including, but not limited to General Economics, Econometrics and Quantitative Methods, Food and Health Economics, Natural Resource and Environmental Economics, Food System Economics and Management, Policy and International Trade, and Economic Growth and Development. The M.S. degree offers both thesis and non-thesis options. Students enrolled in the Ph.D. program may use their Ph.D. coursework to simultaneously earn a master's degree.In the joint Ph.D. program with the Department of Economics, Ph.D. students take a common set of core courses in the first three semesters of the program and a common written qualifying examination. AAEC Ph.D. students then complete field courses in each of their two major fields, and elective courses that support their areas of research specialization. AAEC offers fields in:- applied econometrics, - environmental and resource economics,- food and health economics, - international development and trade, and- rural and regional development. Graduate students pursuing M.S. and Ph.D. degrees are eligible for graduate teaching assistantships and graduate research assistantships.

SPECIAL FACILITIES
Students on assistantship are allocated office space in the department and offices are made available to those students not on assistantship as space allows. All students have access to a well-equipped graduate computer laboratory with microcomputers, laser printers, and scanners.

Many graduate students are allocated personal computers in their office facilities. Computers are networked to servers, which provide a wide variety of word processing, statistical, spreadsheet, mathematical programming, and other software.

Agricultural and Applied Economics Facilities Introduction

Students on assistantship are allocated office space in the department and offices are made available to those students not on assistantship as space allows. All students have access to a well-equipped graduate computer laboratory with microcomputers, laser printers, and scanners. Many graduate students are allocated personal computers in their office facilities. Computers are networked to servers, which provide a wide variety of word processing, statistical, spreadsheet, mathematical programming, and other software.

DEGREES OFFERED

MS Degree

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GRE

General Test: Verbal (153.0), Quantitative (144.0)

M.S. degree: The general requirements for the master's degree thesis option are: (1) a minimum of 30 semester hours, including 24 hours of coursework and 6 hours of research and thesis (AAEC/ECON 5994), (2) completion of a thesis acceptable to the student's advisory committee, and (3) satisfactory performance on a final oral examination.The general requirement for a M.S. degree with applied economics focus non-thesis option is a minimum of 30 semester hours of coursework of which at least 24 hours must be at the 5000-level or above. For the M.S. degree, a student must also pass a final oral or written examination.

PhD Degree

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GRE

General Test: Verbal (500.0), Quantitative (500.0)

Ph.D. degree: The Graduate School requirements for a Ph.D. degree include a minimum of 90 semester hours of graduate credit beyond the baccalaureate, with at least 27 hours of coursework and 30 hours of Research and Dissertation (AAEC/ECON 7994). For the Ph.D. degree in Economics, there are additional core coursework requirements. In the first year of the program, the core requirements include one semester each of mathematical economics and macroeconomic theory, and two semesters of microeconomic theory and econometric theory. In the second year of the program, the core requirements include one semester of applied microeconomic theory, one semester of microeconometrics, and one semester of macroeconomic theory. Students also take the AAEC 5004 seminar course in professional ethics and expectations their first Fall semester and AAEC 6004 Seminar in Professional Engagement and Communication in Spring of their second year.Beginning in the second year of the program, Ph.D. students are required to complete two field courses in each of their two fields, and at least one elective course that supports their fields and areas of research specialization. Beyond the core coursework requirements, individual programs of study are determined jointly by the student and his/her advisory committee chair. Students who are admitted to the Ph.D. program without having completed a master's degree at another institution often earn an M.S. at Virginia Tech as part of their Ph.D. program. The credit hours applied to the master's degree can also be counted toward the Ph.D. coursework requirements. A similar rule applies for students who are initially in a master's degree program and are subsequently admitted to the Ph.D. program. In addition to coursework, Ph.D. students are required to pass three examinations: (1) a written qualifying examination, (2) a written and oral preliminary examination, and (3) a final oral dissertation defense. More information on these requirements is available at the Department's Graduate Program website.

GRADUATE COURSES (AAEC)

AAEC 5004:

Seminar

Formal presentation and discussion of current problems, programs, and research studies in agricultural economics. Presentations and discussions. Repeatable for credit.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5014:

Applied Economic Analytics

Mathematical and statistical methods used in applied economic decision making. Applied mathematical optimization, statistical simulation, data visualization, probability theory and linear econometric models to economic, agricultural, and environmental data and problems. Extensive application of quantitative models and modern programming platforms used in applied economic analysis. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5024:

Mathematical Programming for Economist

Employing economic principles to optimally achieve the goals of firms as a whole. Linear, non-linear, and integer programming are employed to model firm decision making.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AAEC 3004 (UG) OR AAEC 3004 OR ECON 3104 (UG) OR ECON 3104

Corequisite(s):

AAEC 5025:

Applied Microeconomics

Basic economic theory of food and fiber production, food and fiber consumption, agricultural markets, and social welfare as influenced by the agricultural sector. Major emphasis placed on application of theory to current agricultural and resource problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (MATH 1526 (UG) OR MATH 1526, ECON 3004 (UG) OR ECON 3004) OR (ECON 3104 (UG) OR ECON 3104)

Corequisite(s):

AAEC 5026:

Applied Microeconomics

Basic economic theory of food and fiber production, food and fiber consumption, agricultural markets, and social welfare as influenced by the agricultural sector. Major emphasis placed on application of theory to current agricultural and resource problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (MATH 1526 (UG) OR MATH 1526, ECON 3004 (UG) OR ECON 3004, ECON 3104 (UG) OR ECON 3104)

Corequisite(s):

AAEC 5034:

Agribusiness Marketing Policy and Business Strategies

Marketing tools needed to identify and solve the complexity of marketing food and agribusiness products. Contemporary trends, marketing strategies, and problems in the food and agribusiness sector. Pre: Understanding of introductory microeconomic theory. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5044:

Applied Macroeconomics

Nature and linkages between agriculture, natural resources, and macroeconomic variables. Theories and methods used to establish and quantify these linkages. Macroeconomic models to measure the effect of national output, unemployment, interest rates, economic growth, exchange rates, and allocation and distribution of resources on the agricultural sector, the environment, and the international economy. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5054:

Strategic Agribusiness Management

Application of economic theory to operational and strategic decision-making in agribusiness. Analysis and application of the functions of management. Problem recognition and economic analysis of supply chain, marketing, financial, production, and human resource decisions facing agribusiness firms. Assessment of U.S. role in the international marketplace. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5074:

Agricultural and Food Policy

Policy issues related to trade, farm bills, natural resource preservation, and food, nutrition, and health. Global forces impacting U.S. policy. Local, state, and national legislative process. Stakeholder influence on the policy-making process. Policy impacts on stakeholders. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5084:

Contemporary Issues and Responses in Food Systems

Economic analysis of food systems. Analysis of contemporary issues and responses in crop and animal production, food wholesaling, food processing, and food retailing. Economic incentives. Isolated, horizontally, vertically related markets and principal agent theory. Appropriate data and application determination. Directional impacts. Pre: Graduate Standing

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5104:

Research Project Plan

Planning and executing a research project with emphasis on problem identification, formulation of hypothesis, choice of appropriate empirical technique and data sources.

Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5114:

Applied Microeconomic Theory

Theoretical and empirical issues in developing and implementing microeconomic models. Topics include duality, risk, household production, selecting functional forms, aggregation, and numerical partial and general equilibrium models.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECON 5006, (AAEC 5126 OR ECON 5126)
Corequisite(s):

AAEC 5125 (ECON 5125):

Empirical Research Methods in Economics

Extensive treatment of new techniques for economic modeling. 5125: Probability and statistical inference, linear regression and related dynamic models, specification, estimation, misspecification, respecification, identification. 5126: Simultaneous equations, dynamic systems, time series, limited dependent variable models. Permission of the Director of the Graduate Studies required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5126 (ECON 5126):

Empirical Research Methods in Economics

Extensive treatment of new techniques for economic modeling. 5125: Probability and statistical inference, linear regression and related dynamic models, specification, estimation, misspecification, respecification, identification. 5126: Simultaneous equations, dynamic systems, time series, limited dependent variable models. Permission of the Director of Graduate Studies required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): AAEC 5125 (UG) OR AAEC 5125
Corequisite(s):

AAEC 5134:

Agricultural Markets and Prices

Commodity price analysis, including theoretical relationships, analytical techniques and practical applications. Empirical evaluation and forecasting approaches including time series, structural, balance sheet, futures-based and hedonic models. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5154:

International Agricultural Development and Trade

This course focuses on the role of agriculture in economic development and the effects of alternative trade policies and practices in less developed nations. Topics include agriculture in theories of development, population growth, migration, the economic organization of

the peasant-household firm, technological change, institutional change, effects of trade restrictions, exchange rates, trade preferences, regional economic groupings, food aid, trade negotiations, agricultural sector marketing, and project analysis.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECON 3104 (UG) OR ECON 3104
Corequisite(s):

AAEC 5174:
International Agricultural Development and Trade
Agriculture in world economic development, agricultural modernization strategies, and the effects of trade policies and agreements on agriculture. Dimensions of world food, population, income, and natural resource issues; technological and institutional change; trade, capital flows, and foreign aid. Pre. Understanding of introductory microeconomic and macroeconomic theory. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5244:
Rural Development
Theory and methods related to economic development of rural America. Considers the roles of agriculture, resources, human capital, and federal, state and local governments in development processes. Outlines the constraints created by resource scarcity, location and government policy. Quantitative methods in resource development, regional development and impact analysis are introduced.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5424:
Agribusiness Finance and Risk Management
Introduction to corporate finance and risk management in agribusiness. Financial analysis, estimation of capital cost and valuation. Focus on risk management and Environmental and Social Governance (ESG) practices through case studies. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5484 (STAT 5484):
Applied Economic Forecasting
Forecasting economic, agricultural and environmental data using basic linear and non-linear time series models. Emphasis on programming and computational implementation of time series model-selection techniques and practical applications. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5544 (FREC 5544) (GEOG 5544):
Remote Sensing in the Social Sciences
Principles on the use of remotely sensed (satellite) data in social science research, with key applications in environment, agriculture, and economic development. Basic scripting techniques to extract, visualize, and analyze satellite remote sensing data across the electromagnetic spectrum with cloud-based computing platforms. Development of social science research proposals using remotely sensed data and based on review of relevant seminal and current research articles. Pre: Graduate standing.
Credit Hour(s): 4
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5804G:
Fundamentals of Econometrics
Introduction to economic applications of mathematical and statistical techniques: regression, estimators, hypothesis testing, lagged variables, discrete variables, violations of assumptions, simultaneous equations, instrumental variables, panel data methods. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5814G:

Adv Food & Health Economics

Microeconomics of food, nutrition, and health. Overview of nutrition, nutrition recommendations, and implications for economic based decisions. Individual and household food consumption and health production models. Farm to consumer market linkage models with nutrition and health implications. Effectiveness of food and nutrition interventions and policies. Cost-benefit and cost- effectiveness analysis of health interventions. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5824:

Advanced Applied Economic Analytics

Advanced econometric analysis of problems in agricultural and applied economics. Modern techniques in Econometrics, machine learning, and data analytics including multiple regression, classification, instrumental variables, clustering, and regression trees. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

AAEC 5946 (ECON 5946):

Econometric Theory and Practice

An intensive coverage of the most important techniques of econometric estimation and hypothesis testing, addressing the use of both cross-section and time series data, A core sequence in the MA program in both locations. Prerequisite to the research-thesis seminar in Northern Virginia. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AAEC 5126 OR ECON 5126

Corequisite(s):

AAEC 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

AAEC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

AAEC 6004:

Research Seminar and Professional Development

Observation and discussion of research papers, presentation and interview skills, and job market package. May be repeated 7 times with different content for a maximum of 8 credit hours. Pre: Graduate Standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 6214:

Food and Health Microeconomics

Microeconomics of food and health. Overview of nutrition recommendations and implications for economic decisions. Individual and household food consumption and health production models. Farm to consumer market linkage models with nutrition and health implications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AAEC 5126, ECON 5006, ECON 5016, ECON 5124

Corequisite(s):

AAEC 6224:

Food & Health Macro Economics

Introduction to policy and intervention design and evaluation, including review of basic nutrition, contract theory and applications, intervention outcome metrics, nonmarket evaluation, empirical cost effectiveness analysis and treatment effect estimations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5006, (ECON 5126 OR AAEC 5126)

Corequisite(s):

AAEC 6304:

International Trade and Finance

Core models in international trade and finance; current topics in international economics. Ricardian, Hecksher-Ohlin-Samuelson, Dynamic imperfect competition trade theories; Political economy of trade; Trade policy, Factor mobility, Uncertainty, and Intra-industry trade. Mundell-Fleming, Monetary, Real- and Imperfect competition- Micro-foundations theories of international macroeconomics; exchange rate determination; and capital markets. Extensions to monetary and fiscal policy, economic growth, and external debt analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5005, ECON 5015

Corequisite(s):

AAEC 6314:

Topics Applied Dev Econ

Economic theories and empirical methods for measuring poverty, inequality, and vulnerability, and for targeting social programs. Topics include theory of the farm household and empirical methods to measure effects of public policies, interactions between the environment and development policy, methods for measuring technical change and its impacts, effect of social networks on technology adoption, and the role of microfinance in economic development.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5006, ECON 5126

Corequisite(s):

AAEC 6444:

Regional and Urban Economics

An advanced study of the theory and application of regional and urban economics, with particular focus on the spatial aspects of economic activity. Topics include: nature of regional and urban areas, models of regional economies, location choice of firms and consumers, local public finance, housing, transportation, and labor markets.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5005 (UG) OR ECON 5005, (ECON 5126 (UG) OR ECON 5126 OR AAEC 5126 (UG) OR AAEC 5126)

Corequisite(s):

AAEC 6524:

Env Theory & Policy Analysis

Advanced coverage of the theory of environmental economics and policy. Topics covered in the course include: theory of externalities and public goods, theory behind policy instruments, issues with non-point source and transboundary pollution, and the role of the political economy for environmental problems.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5006

Corequisite(s):

AAEC 6554 (ECON 6554):

Panel Data Econometrics

Introduction to major panel data techniques and modeling ideas currently employed (e.g., dynamic panel, panel for discrete choice model, treatment effect and program evaluations etc.), including both statistical theory derivations and practical applications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (AAEC 5124 OR ECON 5124), AAEC 5126

Corequisite(s):

AAEC 6564 (STAT 6564) (ECON 6564):

Bayesian Econometric Analysis

Bayesian estimation of economic models, with focus on Gibbs sampling, hierarchical modeling, data augmentation, and model search. Strong emphasis on programming and computational implementation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AAEC 5126 OR ECON 5126 OR STAT 5304 OR STAT 5444

Corequisite(s):

AAEC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AAEC 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

AGRICULTURAL AND LIFE SCIENCES

Professors: Azenegashe Abaye; Renee Boyer; Douglas Pfeiffer; Kerry Redican; Rickie Rudd; Susan Sumner; Gregory Welbaum; Kang Xia;

Associate Professors: Antonius Baudoin; Alan Ealy; Matthew Eick; Joseph Eifert; John Galbraith; William Hession; Eric Kaufman; Sally Paulson; Megan Seibel; Donna Westfall-Rudd; James Westwood;

Assistant Professors: Angela Anderson; Thomas Archibald; Luciana Bergamasco; Tiffany Drape; Erica Feuerbacher; Curtis Friedel; Jennifer Jones; Joshua Kardos; Vitor Mercadante; Carlin Rafie; Richard Rateau; Hannah Scherer; Roger Schuerch; Karen Vines; Jennifer Zabinsky;

Associate Professor of Practice: Dixie Dalton;

General Contact: jejone18@vt.edu

Academic Progress: jejone18@vt.edu

Graduate Site: http://www.cals.vt.edu/online/index.html

This master's degree program has been designed for potential students who are place bound, but would still like to pursue a rigorous graduate-level degree. Courses and the final project are arranged to meet the goals of the student. The student selects one of eight concentration areas on which to focus: Agribusiness, Applied Animal Behavior and Welfare, Applied Nutrition and Physical Activity; Education; Environmental Science; Food Safety and Biosecurity; Leadership Studies; and Plant Science and Pest Management. In addition to course work in the chosen Concentration Area, courses are required from a Core Curriculum and a final project and report is required.

SPECIAL FACILITIES

This degree program offers flexibility in that most courses are offered asynchronously, allowing work to be completed during a time that is convenient for the individual student. Students must have access to a computer and online resources. High speed access is highly recommended; some course materials may not work smoothly with slower dial up systems.

Agricultural and Life Sciences Facilities

The program is completely web-based and allows students to successfully earn the degree without visiting the Blacksburg campus.

DEGREES OFFERED

MS Degree

Offered In (Virtual)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The student designs a program of at least 30 credits. Nine credits must include courses in the core. Each student selects 12 credit hours from their selected concentration area. Three credit hours are selected as electives, generally from another concentration. Six credit hours are taken in the form of research hours within the concentration area, culminating in a final scholarly report.

Degree Concentrations:

Applied Nutrition and Physical Activity

The Applied Nutrition and Physical Activity concentration is designed for students with a science, health-related, community, or education background who wish to advance and expand their nutrition and physical activity knowledge and skills. Courses offer an evidence-based perspective on applied nutrition and exercise across the healthspan. A focus on critical inquiry, problem solving, leadership, and successful business practices in nutrition and physical activity is carried throughout. Upon completion of the OMALS degree with a concentration in Applied Nutrition and Physical Activity each student will be able to: Demonstrate a foundational understanding of nutrition and physical activity sciences and their application to health promotion. Demonstrate an in-depth knowledge in applied nutrition, physical activity, or public health policy as dictated by the student's area of specialization. Apply research methods in nutrition, physical activity, or public health to design, implement, and evaluate projects or programs. Apply nutritional, exercise, or public health policy practices to assess and implement best practice interventions for health and well-being. Communicate nutrition, exercise, or public health messages across diverse audiences.

Education

Increasingly, individuals within the agricultural and life sciences are asked to train others on new techniques or equipment, develop programming that engages the public, or communicate new concepts in a variety of different settings to a diverse group of people. The Education concentration is designed for individuals desiring to advance their teaching/learning, leadership, extension and communications skill sets in this dynamic and evolving field. This in-depth program will provide concrete strategies for assisting individuals and communities with diverse needs and interests, and providing them with the abilities to acquire and retain the information shared, including youth and adult program management, program curriculum design, STEM integration in agriculture education, and service to international service and partnerships. This program is designed to advance your position as an agricultural leader, educator, and communicator. Upon completion of the OMALS degree with a concentration in Education each student will be able: Examine the scholarly literature and illustrate connections to the practice of teaching and learning Design, implement and evaluate educational curriculum, programming and outreach in agricultural and life sciences Integrate research based agricultural, leadership, and community educational models into practice Perform and evaluate research applications in agricultural, leadership, and community education Evaluate the use of technology in agricultural, leadership, and community education curriculum

Environmental Sciences

The Environmental Science concentration will provide students with the knowledge and skills to solve real-world environmental issues. As a student in this program, you will interact with faculty and professionals in the field. Working through hands-on activities you will gain a greater understanding of environmental science theory and practical application. This tailored educational experience will position you to effectively and strategically lead in this field. Upon completion of the OMALS degree with a concentration in Environmental Science each student will be able: Demonstrate breadth and depth of interdisciplinary knowledge related to complex environmental issues and processes. Design, implement, and evaluate an assessment and mitigation plan for diverse at-risk ecosystems. Apply a variety of regulatory practices, standards, or policies related to water and soil quality and use. Identify, analyze, and evaluate evidence-based literature and practice related to water and soil quality. Apply research methods to design, implement, and evaluate sustainable approaches of environmental management for a variety of at risk ecosystems.

Food Safety and Biosecurity

The Food Safety and Biosecurity concentration will build on a student's knowledge of food safety, security, sanitation, and microbiology. It is designed for individuals interested in the microbiological safety of food, water and the environment, including the development and enforcement of laws and regulations affecting food production and processing, the implementation of food safety management programs, and the biosecurity of food supplies in developing countries. Upon completion of the OMALS program with a concentration in Food Safety and Biosecurity each student will be able to: Demonstrate breadth and depth of knowledge of evidence-based food safety and food biosecurity practices. Apply scientific literature to critically evaluate the practices of legal and regulatory issues on food safety and food biosecurity Demonstrate in-depth knowledge of fundamental concepts relevant to food safety and food biosecurity practices across diverse agriculture scales (local, state, national, and global). Design, implement, and evaluate food safety and food biosecurity management programs and practices. Identify sources of food safety and food biosecurity information and distinguish reliable sources from unreliable sources.

Leadership Studies

The Leadership Studies concentration prepares individuals with interdisciplinary skills to be well-rounded agricultural professionals, developing leaders, educators, and communicators to lead, teach and communicate about current agricultural issues facing society today. Students will gain the expertise necessary to lead in a diverse and multicultural environment. Programmatic emphasis is placed on leadership in a global society, problem-solving, and the role of agricultural professionals as agents of change in our communities throughout the world. Upon completion of the OMALS degree with a concentration in Leadership Studies each student will be able to: Demonstrate leadership for effective problem solving with groups, organizations, and communities. Critically analyze leadership theory and practices through scholarly inquiry. Examine social responsibility in diverse and multicultural environments. Design, implement, and evaluate collaborative leadership efforts in real-world settings.

Plant Science and Pest Management

The Plant Science and Pest Management concentration will prepare students in agriculture-related roles to have a broader understanding of the diverse industry, including issues concerning production, business, economics, communication, pest management, and regulations. Students will gain a sophisticated understanding of this interdisciplinary field with specialized skills in areas such as weed science, plant pathology, and crop management. Upon completion of the OMALS degree with a concentration in Plant Science and Pest Management each student will be able to: Demonstrate in-depth multidisciplinary knowledge of fundamental concepts relevant to plant science and pest management practices across diverse agriculture scales (local, state, national, and global). Examine and apply the evidence-based literature to resolve relevant complex plant science and pest management issues within multiple agricultural sectors. Design, implement, and evaluate plant science and pest management programs and practices across diverse scales of agriculture. Analyze the research applications/models/procedures to demonstrate interconnections between plant science, pest management, and human ecology, and animal health. Apply multimedia strategies to communicate topics and concepts that enhance plant science and pest management practices in diverse communities and scales of agriculture.

Agribusiness

The Agribusiness concentration prepares individuals to analyze, assess, and contribute to the ever-evolving, broadly-defined agribusiness industry by developing skills in management, marketing, economics, finance, policy, and quantitative analysis. Students will gain the skills necessary to contribute as employees or managers within the broad industry of agribusiness, including the sectors of input supply, farm production, and output marketing. Emphasis is placed on developing skills for the diverse, multicultural workplace in an increasingly global society, with a focus on critical thinking and problem-solving within the firm, farm, or support organization. Upon completion of the OMALS degree with a concentration in Agribusiness, each student will be able to: Demonstrate management skills for effective interactions with coworkers or clients. Develop a marketing plan for a product, service, or training. Evaluate impacts of micro- and macroeconomic conditions on the organization. Analyze and interpret financial statements. Assess data and determine their implications for the organization.

Applied Animal Behavior and Welfare

The applied animal behavior and welfare concentration is designed for students who are interested in animal behavior and the welfare of animals in applied settings and want to expand their understanding of behavioral principles to improve the lives of animals and their caregivers. The coursework satisfies the course requirements to become an Associate Certified Applied Animal Behaviorist through the Animal Behavior Society and the hands-on work can be geared towards satisfying the case-study or research paper requirements for certification. Courses offer an evidence-based, comprehensive perspective on animal behavior and principles of effective behavior change, drawing from the fields of applied behavior analysis and ethology. The courses focus on critical inquiry into the causes of behavior and solutions to behavior and training issues, problem solving in applied settings, ethical training methods and professional interactions, and leadership in the field of applied animal behavior. As part of their coursework, students will complete a hands-on project and have the option to participate in a week-long hands-on workshop on training, behavior, and welfare with a lead instructor in this emphasis. Upon completion of the OMALS degree with a concentration in Applied Animal Behavior and Welfare each student will be able to: Demonstrate a comprehensive understanding of behavioral principles from the fields of applied behavior analysis and ethology. Identify, describe, and measure behavior and its environmental determinants in a variety of applied scenarios. Assess the influence of biological and psychological principles on behavior in applied settings. Construct and implement training and behavior plans for diverse behavioral/training scenarios using evidence-based behavioral principles, and following industry best practices and ethical guidelines. Critically and empirically assess the efficacy of behavior and training interventions using appropriate research methods and utilize those assessments to modify future intervention decisions. Communicate evidence-based behavior and training principles and solutions to diverse audiences. Synthesize the biological and psychological factors that influence behavior. Serve as an industry leader promoting evidence-based best practices and scientific approaches.

GRADUATE COURSES (ALS)

ALS 5024:

Building Multicultural Competence in Agriculture and Life Sciences

Diversity and inclusion within agriculture and life sciences in academic settings and communities: university, national, and global. Virginia Tech Principles of Community and appropriate avenues of redress. Shared responsibilities and issues of privilege, bias, power, prejudice, and discrimination. Governmental and institutional policies and their effects on diversity and inclusion. Pre: Graduate Standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5034:

Mathematical Modeling of Metabolic Systems

Techniques used to model nutrient metabolism and associated cellular and systemic responses including compartmental analyses, numerical integration, sensitivity analyses, and parameter estimation. Interpretation and extension of experimental data including isotopic tracers. Prediction of biological responses to nutrient inputs. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5064:

Seminar in Molecular Cell Biology and Biotechnology

Review and discussion of current problems and literature in molecular cell biology and biotechnology by students, VPI&SU faculty and outside speakers. Students give formal presentations of research results or current literature. May be taken on pass-fail basis. Students enrolled in the MCBB Ph.D. option will be required to give one formal presentation on an A-F basis. Graduate status in participating MCBB departments required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5084:

Advanced Ruminant Nutrition Colloquium

Research papers in nutrition of ruminant animals (beef, dairy, sheep) will be reviewed. Research papers will be selected from scientific journals such as the Journal of Dairy Science, the Journal of Animal Science, the Journal of Nutrition, and Animal Feed Science and Technology. May be repeated (no restriction on number of times). Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5094:

Effective Grant Writing for the Biomedical aand Behavioral Sciences

The grant writing process and developing student skills for successful grant writing to support research enterprises. Students will prepare a mock research grant proposal for obtaining funds from the National Institutes of Health, National Science Foundation, or the US Department of Agriculture and participate in panel review of grant proposals of peers.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): APSC 5004 OR (ALS 5064 OR BIOL 5064 OR BCHM 5064 OR PPWS 5064)

Corequisite(s):

ALS 5104:

Communicating Research and Leadership in Agriculture and Life Sciences

Principles and strategies for effective leadership and communication in agricultural and life sciences (ALS). Analysis, synthesis and translation of research information for use in practical settings. Effective ALS knowledge. Evaluation of research design and methodology in action research. Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5115:

Nutrition

Digestion, absorption and metabolism of nutrients in animals including humans. 5115: Digestive physiology; digestion and absorption; bioenergetics; and carbohydrate and lipid metabolism with emphasis on substrate sources, interrelationships, and factors affecting utilization and metabolism. Graduate Standing required. 5116: Absorption, metabolism and function with emphasis on physiological and biochemical aspects of protein, amino acid, vitamins, and minerals; epidemiological, biochemical, cellular or molecular methodologies useful for study of macronutrients and micronutrients and their biological functions also will be covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5116:

Nutrition

Digestion, absorption and metabolism of nutrients in animals including humans. 5115: Digestive physiology; digestion and absorption; bioenergetics; and carbohydrate and lipid metabolism with emphasis on substrate sources, interrelationships, and factors affecting utilization and metabolism. Graduate Standing required. 5116: Absorption, metabolism and function with emphasis on physiological and biochemical aspects of protein, amino acid, vitamins, and minerals; epidemiological, biochemical, cellular or molecular methodologies useful for study of macronutrients and micronutrients and their biological functions also will be covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ALS 5115

Corequisite(s):

ALS 5134:

Community-Based Applications of Qualitative Inquiry

Community-based applications of qualitative inquiry in Agricultural and Life Sciences. Qualitative methodology in community-based research with a focus on ethics and inclusivity. Interviews and focus groups. Professional best practices and enhance communication. Best practices for a community approach, interview facilitation, and reporting for professional audiences. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5204:

Research and Information Systems in the Life Sciences

A focus on research techniques and processes for life science professions. Topics include: history of applied life sciences, current structure of the scientific enterprise, the scientific method and quality assurances, researching the literature, scientific writing and presentation of research results, instructional techniques, professionalism, and ethical considerations. Information technology is employed throughout the course. Students learn to use digital technologies for communication, presentation, and publication.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5214:

Information Systems and Research in the Life Sciences

Research techniques and processes used in the life science professions. History of applied life sciences, structure of the scientific enterprise, the scientific method and quality assurances, researching the literature and critically evaluating information, scientific writing and communication of research results, professionalism, and ethics. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5224:

Introduction to Genomic Data Science

Analysis of genomic data for applications in agriculture and life sciences. Computational tools for genomic data processing and quality control. Interpret results from genomic experiments. Summary statistics, machine learning and methods of visualization for genomic data. High Performance Computing (HPC) systems for genomic analysis. Genomic data analysis pipelines. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5234:

Advanced Concepts in Community Food Systems

Examination of the economic, political, social, and cultural issues related to community food systems and agricultural practices. Local and regional food systems development, food production and biotechnology, food sovereignty and security, and population and environmental health. Analysis of models, strategies, and policies of national food systems. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5304:

Advanced Physiology and Anatomy of Domestic Animals

Mammalian physiology and anatomy will be evaluated in domestic animals, laboratory animals, and primates. Emphasis will be on the cardiovascular, renal, respiratory, neural, muscle, and digestive physiology.

Credit Hour(s): 0 OR 5

Lecture Hour(s): 0 OR 4

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): ALS 2304 (UG) OR ALS 2304

Corequisite(s):

ALS 5324:

Research Ethics in Agriculture and Life Sciences

Principles of and skills development in research ethics to enhance professional preparation in agriculture and life sciences. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5334:

Professional Communication Agriculture & Life Sciences

Principles of, and skill development in, academic communication to enhance professional preparation in the agricultural and life sciences. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5404:

Management and Analysis of Agricultural Experiments

Problem-based learning approach to managing, analyzing, and interpreting experimental data common to agricultural research. Programming for statistical software packages and dissection of algorithms to troubleshoot and revise programming code.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5615, STAT 5616

Corequisite(s):

ALS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ALS 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5964:

Field Work/Practicum

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ALS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 6314:

Endocrinology

Hormones produced in animals and their roles in development, growth, appetite, digestion, metabolism, lactation, reproduction, homeostasis, and behavior. Mechanisms by which hormones act and the factors that regulate the production and action of hormones. Endocrine disorders and hormone-based application in medicine and animal agriculture. Major methodologies in current endocrine research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ALS 5304 (UG) OR ALS 5304) OR ALS 5344

Corequisite(s):

ALS 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALS 7964:

Field Studies

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AGRICULTURE, LEADERSHIP, AND COMMUNITY EDUCATION

Tracy Rutherford, Head

Professors: Loy Crowder; Eric Kaufman; Kimberly Niewolny; Rickie Rudd; Tracy Rutherford;

Associate Professors: Thomas Archibald; Curtis Friedel; Hannah Scherer; Donna Westfall-Rudd;

Assistant Professors: Austin Council; Tiffany Drape; Stanley Mariger; Megan Seibel; Hannah Sunderman;

Community Viability Chair of Excellence: Rickie Rudd;

Adjunct Faculty: Natalie Ferand; Makane Kane; Steven Manchester; Ya Cor Ndione; Joseph Obeng-Baah; Frank Shushok;

Collegiate Assistant Professors: David Milliken; Jerald Walz;

Graduate Contact: niewolny@vt.edu

General Contact: gbdempsey@vt.edu

Graduate Site: https://www.alce.vt.edu/student-info/graduate.html

The Department of Agricultural, Leadership, and Community Education (ALCE) is nationally recognized as a comprehensive program encompassing teaching and learning, extension, community development and education, and leadership in agriculture. We are social scientists practicing in the context of agriculture and life science. Our research, teaching, and extension programs enhance and strengthen the people engaged in agriculture life sciences. Graduate studies in ALCE are grounded in our programmatic research in problem solving, leadership development, critical thinking, program development and evaluation, secondary education, non-formal education, and professional development. These research areas form our concentration areas of teaching and learning, leadership and social change, and community education and development.

SPECIAL FACILITIES

Virginia Tech's Department of Agricultural, Leadership, and Community Education is located in Litton-Reaves Hall. In addition, we work with county extension offices, community partners, and secondary schools across the state.

Litton-Reaves Hall

The main office for ALCE is located in 214 Litton-Reaves Hall. Faculty offices are also located in Litton-Reaves.

DEGREES OFFERED

MS Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The department offers an on-campus M.S in Life Science degree in Agricultural and Extension Education (AEE) and partners with the College of Agriculture and Life Sciences Online M.S. in Agricultural and Life Sciences (OMALS) degree. In addition, we are a collaborator with the Virginia Tech School of Education in offering an M.S. degree for agriculture teacher certification MSED/EDCT. MSLFS/AEEThe Master of Life Sciences requires students to complete a thesis and final examination. A considerable amount of time is spent conducting research and writing. This degree is intended for students who plan to pursue a Ph.D. in teaching and learning, community education and development, or leadership and social change. MS/OMALS (Education Concentration or Leadership Studies Concentration)The Master of Agricultural and Life Science is a non-thesis degree intended for practicing professionals in education, extension or other forms of community development work. This degree is delivered by distance to students who are place-bound. Although this degree is intended for students who do not wish to pursue a doctoral degree, it does not eliminate students from that academic option if chosen in the future. Each student will complete a final project that adds to the knowledge base of best practices in our profession. The project defense (final examination) will be held at the end of a student's program. MSED/EDCTThe Master of Science in Career and Technical Education is offered on the Virginia Tech campus for students seeking certification in teaching secondary agricultural education. This program is housed in the School of Education and delivered in collaboration with ALCE. Students who complete the program receive a degree from the School of Education. This is a non-thesis degree. Students are required to pass a comprehensive examination to complete the program.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (233.0)

iBT: (90.0)

The Ph.D. in Life Sciences with an emphasis in Agricultural Education (PhD) is intended for students who desire to be faculty in universities delivering comprehensive programs in agricultural, leadership, and community education, Extension professionals, leaders in educational programs and community development, or social science researchers. Our program focus allows us to deliver a customized program for students preparing for professional roles. Courses, experiences, and research are all focused on providing a solid foundation for graduates who will be initially competitive and highly productive throughout their career. Our Ph.D. program provides a solid background in research and students are expected to produce unique discoveries in teaching and learning, community education and development, and leadership & social change. Students are expected to publish and present in the program as well as assist in securing funded projects. Faculty members work with students to meet individual educational goals. Our faculty are known for strong advisement and personal attention for each student. Students are provided with opportunities to teach in formal classrooms and non-formal settings, conduct meaningful research, and deliver outreach programs. The degree requires a comprehensive examination to enter Ph.D. candidacy. The comprehensive exam and oral defense is an opportunity for a student to showcase their abilities in the areas of integrating and synthesizing information relevant to their program. Advisor and committee member roles at this stage include 1) providing support and encouragement, 2) providing collegial and constructive dialogue, 3) creating an environment where ideas are shared in a professional environment free of condescension, derision and hostility, 4) providing feedback in a timely manner and 5) completing their tasks with all relevant signatures or other paperwork. Each student will complete a dissertation that adds to the knowledge base of our profession. The dissertation defense (final examination) will be held at the end of a student's program.

GRADUATE COURSES (ALCE)

ALCE 5014:

Non-Formal Teaching & Learning: Principles & Methods

Principles and methods associated with non-formal teaching and learning for community and extension education as well as secondary educational settings such as agricultural education. Concepts and practical knowledge for designing, integrating, and justifying non-formal educational experiences for learners. Learning frameworks and approaches that emphasize the role of participation, facilitation, and other student-centered teaching and learning approaches in agriculture and life science professions. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 5044:

Program and Curriculum Design in Agricultural and Extension Education

Methods involved in the organization, management, and evaluation of programs and curricula for agricultural education and cooperative extension.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5054:

STEM Integration in Agricultural Education

Contemporary methods, strategies, and justification for incorporation of science, technology, engineering and mathematics (STEM) concepts and practices into secondary agricultural education programs. Use of best practices for STEM teaching and learning and enhancement of STEM content in existing agriculture courses. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5074:

Foundations of Agricultural, Leadership, and Community Education

The history and current state of agricultural education and extension, leadership, and community viability. Current issues in agriculture, leadership, and community education as they relate to agriculture education and extension domestically. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5104:

Research Applications in Agricultural and Extension Education

Professional applications of research from the perspective of the research consumer rather than the researcher. Locating, accessing, interpreting, evaluating, applying, and communicating the results of research to the lay public in agricultural and extension education settings. Emphasis on professional and scientific research published in agricultural, applied life sciences, agricultural education, and cooperative extension outlets.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5114:

Serving Intnl Ag & Education

International agricultural and outreach education in both developed and developing countries. Skills formal and non-formal educators need in an international setting. Especially for educators and leaders in agriculture and Cooperative Extension. Graduate standing required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5154:

Partnerships and Volunteerism

Students will develop competencies in the development and direction of community volunteer partnerships and collaborations. Students will explore current volunteer development models, collaboration process theory, and key management areas including: visioning, organizing a partnership or collaboration; creating motivating volunteer positions; recruiting, screening, and interviewing; orientation and training; supervising; evaluation; retention and resolution; risk management, and measuring program effectiveness.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5204:

Evaluation of Extension and Outreach Programs

Theory and practice of program evaluation in community education settings such as extension and outreach programs. Evaluation concepts and methods to plan and execute well-constructed program evaluations. Major traditions, current controversies, and new directions in evaluation. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5224:

Team Science, Cooperation, and Interdisciplinary Work

Theoretical and conceptual basis for thinking about, guiding, and supporting team science and cooperative processes for interdisciplinary research, programming, and outreach. Current scholarship and concepts of individual and team readiness, effectiveness, protocols, training, and outcomes in team science and cooperative process contexts. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5304G:
Community Education and Development
Comprehensive examination of community education and development. Community/sustainable community development, strategies for mobilizing social change in/with communities. Explore participatory, popular, and community-based education from rural and urban settings. Globalization, sustainability, and social movement discourses with emphasis on agricultural, health, and food system examples. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5564:
International Agriculture & Diplomacy
Advanced study on agricultural leadership. U.S. geostrategic context that includes history, geography, natural resources, cultural identity, governance, macro-economic policy, and security interests shaping the U.S. and international agricultural foreign policies. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5614:
Politics and Practice of Food Security and Social Justice
Interdisciplinary and intersectional exploration of current issues related to the politics and practice of food security. Concepts of community food security, food sovereignty, food justice, and agricultural sustainability from local, regional, and international perspectives. Empirical examples and conceptual frameworks to address health equity, community resiliency, and food system social justice. Regional storytelling research project with food and farming practitioners. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5704:
Systems Thinking Pedagogy and Praxis
Strategies promoting systems thinking in formal and non-formal educational and community contexts. Instructional design for developing systems thinkers. Systems approaches to understanding problematic situations and creating change using agricultural, community-based, and extension education examples. Foundational complex systems concepts and systems thinking perspectives for social and socio-ecological systems. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5754:
Internship in Ag&Extension Ed
Student participation in a planned clinical experience under supervision of a university faculty member in an approved, appropriate professional setting. A written Internship Agreement must be completed and approved before the internship begins.
Credit Hour(s): 1 TO 12
Lecture Hour(s): 1 TO 12
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ALCE 5904:
Project and Report
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ALCE 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 5964:

Field Study

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ALCE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ALCE 6014:

Theoretical Foundations of Non-Formal Learning

Overview of the theory and practice of non-formal learning emerging paradigms, and historical debates. Development of specific pedagogies based on non-formal learning theories. Education settings and issues relevant to agricultural and extension educators including extension education, community-based education, agriculture training and international development, work place education, and social movements/social activism. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 6234 (HNFE 6234):

Theory & Practice of Community-Based Participatory Research

The theory and practice of Community-based Participatory Research (CBPR). Empirical examples from community development, agriculture and food systems, community health, and human nutrition. Principles of CBPR, practical and ethical issues in collaborating with communities, participatory action methods, and approaches to evaluation. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 6415:

Introduction to Graduate Teaching Scholars (GTS)

6415: Theories of learning for instruction of college-level agricultural and life sciences courses. Student-centered teaching strategies. Student assessments based on classroom observations. Pre: Graduate Standing. 6416: Strategies for college-level agricultural and life sciences course instructional design. Postsecondary teaching. Pedagogy using classroom observations, specialized topics in teaching, and experience with mentors to develop individual teaching skills and pedagogy. Pre: Graduate Standing.

Credit Hour(s): 2

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 6416:

Introduction to Graduate Teaching Scholars (GTS)

Strategies for college-level agricultural and life sciences course instructional design. Postsecondary teaching. Pedagogy using classroom observations, specialized topics in teaching, and experience with mentors to develop individual teaching skills and pedagogy.

Credit Hour(s): 2

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): ALCE 6415

Corequisite(s):

ALCE 6425:

University Teaching Development (GTS)

6425: Guided experiences in planning and teaching courses at the university level. Utilize the first year experiences to develop skills and practice in lesson planning, course management, and advanced teaching strategies. Work with faculty mentors to plan and organize teaching materials. 6426: Continued development of teaching knowledge and skills appropriate for contemporary secondary classrooms. Examination of effective classroom management strategies and resources for continued development of professional teaching practice. Implement teaching skills and knowledge co-teaching course assigned in the program.

Credit Hour(s): 2

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): ALCE 6416

Corequisite(s):

ALCE 6426:

University Teaching Development (GTS)

Continued development of teaching knowledge and skills appropriate for contemporary postsecondary classrooms. Examination of effective classroom management strategies and resources for continued development of professional teaching practice. Implmement teaching skills and knowledge co-teaching course assigned in the program.

Credit Hour(s): 2

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): ALCE 6425

Corequisite(s):

ALCE 6435:

Engagement in University Teaching (GTS)

6435: Preparation for faculty with teaching related responsibilities. Advising and mentoring undergraduate students, developing effective student assessments, and application of contemporary student centered teaching methods in college classrooms. 6436: Pursue postsecondary faculty positions with teaching appointments. Preparation for the first year of postsecondary teaching including managing effective peer observations and feedback, finding innovative teaching resources at different universities, mentoring graduate students, and engaging in scholarship of teaching and learning.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): ALCE 6416

Corequisite(s):

ALCE 6436:

Engagement in University Teaching (GTS)

6435: Preparation for faculty with teaching related responsibilities. Advising and mentoring undergraduate students, developing effective student assessments, and application of contemporary student centered teaching methods in college classrooms. 6436: Pursue postsecondary faculty positions with teaching appointments. Preparation for the first year of postsecondary teaching including managing effective peer observations and feedback, finding innovative teaching resources at different universities, mentoring graduate students, and engaging in scholarship of teaching and learning.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): ALCE 6435

Corequisite(s):

ALCE 6974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ALCE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 7964:

Field Studies

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ALCE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ALLIANCE FOR SOCIAL, POLITICAL, ETHICAL, AND CULTURAL THOUGHT

Brian Britt, Program Director

Emeriti Faculty: Elizabeth Fine; Joseph Pitt; Anita Puckett; Richard Rich; Michael Saffle; Richard Shingles; Robert Siegle;

Professors: Onwubiko Agozino; Mark Barrow; France Belanger; Brian Britt; David Brunsma; Francois Debrix; Arthur Ekirch; Edward Ewing; Jessica Folkart; Matthew Gabriele; Thomas Gardner; Anthony Harrison; Karen Hult; Sylvester Johnson; James Klagge; Bettina Koch; Robert Leonard; Douglas Lind; Ilja Luciak; Timothy Luke; Su Fang Ng; Lydia Patton; Katrina Powell; Rachel Scott; Brett Shadle; Max Stephenson; Ioannis Stivachtis; Gerard Toal; Vinodh Venkatesh; Peter Wallenstein; Ronda Watson; Edward Weisband; Laura Zanotti; Bonnie Zare;

Associate Professors: Danna Agmon; Aaron Ansell; Clair Apodaca; Paul Avey; Shannon Bell; Cermetrius Bohannon; Aaron Brantly; Daniel Breslau; Nicholas Copeland; Giselle Datz; Priya Dixit; Carmen Gitre; Heather Gumbert; Saul Halfon; Matthew Heaton; Ashley Heflin; Benjamin Jantzen; Caitlin Jewitt; Sharon Johnson; Melanie Kiechle; Christine Labuski; Michael Moehler; Marian Mollin; Wayne Moore; Amy Nelson; Scott Nelson; Zhange Ni; Kimberly Niewolny; Paulo Polanah; Besnik Pula; Patrick Roberts; Emily Satterwhite; Andrew Scerri; Peter Schmitthenner; Helen Schneider; Paula Seniors; Carolyn Shivers; Eric Standley; Robert Stephens; Jessica Taylor; Kelly Trogdon; Anna Zeide;

Assistant Professors: Amaryah Armstrong; Andrea Baldwin; Binio Binev; Letisha Brown; Mauro Caraccioli; Danille Christensen; Carolyn Commer; Cara Daggett; Brandy Faulkner; Bikrum Gill; Edward Gitre; Nicholas Goedert; Rebecca Hester; Lucien Holness; Eric Jardine; Karin Kitchens; Karen Kovaka; Jennifer Lawrence; Allan Lumba; Jordan MacKenzie; Shaily Patel; Desiree Poets; Audrey Reeves; Sharone Tomer; Andrew Wadoski; Fabian Wendt; Trevor Wilson;

Visiting Faculty: Karl Precoda;

General Contact: aspect@vt.edu

Student Handbook: http://liberalarts.vt.edu/departments-and-schools/alliance-for-social-political-ethical-and-cultural-thought.html

The Ph.D. in Social, Political, Ethical and Cultural Thought (ASPECT) prepares graduate students to undertake theory-based, problem-centered, and interdisciplinary analysis informed by social, political, ethical and cultural thought. ASPECT is designed to interest those seeking a program of study with a framework wider than that of a specialized traditional disciplinary department. The program is unique in offering a curriculum that fosters research and teaching that communicates theory across the limits that frequently divide between units in the social sciences, humanities, and professional schools. The program promises to place in tandem bodies of thought and their research applications that have frequently cast divisions along fault line of political theory vs. cultural studies, social theory vs. ethical thought, etc. It is the modest ambition of the ASPECT curriculum, by contrast, to foster a research and teaching program that enables Ph.D. students to pursue appropriate course work and research commensurate with the complexities of the issues they aim to investigate. The curriculum stresses flexibility and originality. It permits a focus on overarching questions by offering training in areas of concentration as well as education in interdisciplinary ways of knowing. Each area of concentration, in turn, is composed of a cluster of multidisciplinary offerings. Students will be prepared to teach introductory and required courses in particular disciplines through their graduate teaching assistantships. However, their Ph.D research will address questions that span a number of different approaches and fields in a truly interdisciplinary manner. The ASPECT Ph.D. curriculum is supported both by some seventy faculty affiliates (see: http://liberalarts.vt.edu/departments-and-schools/alliance-for-social-political-ethical-and-cultural-thought.html) with tenure homes in twelve campus departments and three colleges: the College of Architecture and Urban Studies, the College of Business and the College of Liberal Arts and Human Sciences, including the four core departments of History, Philosophy, Political Science, and Religion and Culture.

SPECIAL FACILITIES

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DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

The ASPECT doctoral program at Virginia Tech is for students who have previously earned an M.A. or equivalent (e.g. JD, MBA, MS) before pursuing doctoral study. Under the assumption that students accepted into the ASPECT program with a Masters degree or equivalent either from Virginia Tech or elsewhere have received credit for 30 credit hours, they then will undertake a minimum of 60 semester hours of further study, leading to the defense of a Ph.D. The Ph.D. curriculum concentrates on interdisciplinary methodological and theoretical issues. Therefore, ASPECT is where social, political, ethical, and cultural thought are put to work in understanding social and individual transformations in contemporary and historical contexts. Course requirements for the Ph.D. can ordinarily be completed during two years of residency and entail successful completion of 42 credit hours, leading to the defense of a Ph.D. dissertation proposal and preliminary exams during the fourth semester. Thereafter, dissertation research will be undertaken under the supervision of a multidisciplinary advisory committee and remaining credits may be earned either by taking additional classroom courses or research and dissertation credits. Students pursuing the ASPECT Ph.D. select a major and a minor concentration chosen from among four areas: 1) social thought, 2) political thought, 3) ethical thought, and 4) cultural thought. Additional ASPECT courses requirements offer education in interdisciplinary theory, methodology, and professional development.The ASPECT curriculum consists of four kinds of classroom courses: 1) All candidates will take 12 credit hours of core ASPT courses (ASPT 6004, ASPT 6104, ASPT 6204, and ASPT 6904); 2) 21 credit hours selected from ASPECT cross listed departmental offerings (six of the latter are brand new courses expressly designed to support program goals), 3) six credit hours in social science or humanistic research methods; and, 4) three credit hours in pedagogical practices (GRAD 5114). All students are required to identify a major and minor field (one each selected from the four concentration areas). The 21 credit hours mentioned in (2), are selected to fulfill the major and the minor areas of concentration, with 12 credit hours in the major and 9 credit hours in the minor area. No more than 9 credit hours can be taken in one department in fulfillment of the major area, no more than 6 from one department in the minor area.

GRADUATE COURSES (ASPT)

ASPT 5014:

Religion and the Public Sphere

Debates about the resurgence of religion and about defining religion. Theories of various thinkers concerning what role religion should play in the public sphere. Theories about secularism, secularization, and the differentiation between religion and politics. Social-scientific, phenomenological, and cultural approaches to the study of religion. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 5114 (PSCI 5114):

Critical Research Design

Analysis of challenges related to power and ethics in the design of political research. Special emphasis on research question formulation, case selection, identification of sources, and qualitative research methods. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 5124:

Rel and Modernity in the West

A study of the relationship between religion and modernity in the West, with analysis of whether modern society is disenchanted or secularized, or whether religion has remained a potent force in western society and thought. Through a survey of some of the major thinkers and themes of modern religious thought, we will consider the philosophical, economic, political, and legal aspects of the location of religion in the modern world. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 5134 (RLCL 5134):

Islamic Political Thought

The course will review the most significant elements of Islamic political thought throughout Islamic history: the teaching of the Quran, the formation of political thought in the medieval period, and the main trends of political thought in the modern world, including in the West. It will examine the connection between Islamic political thought in the medieval and modern periods. Graduate standing requires.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 5214 (HIST 5214):

Topics in Global History

A variable content course exploring historiographical approaches to the study of global history from the classical age to the present. Special emphasis on chronological frameworks, histories and theories of globalization, and implications of new scholarship in global history for research and teaching. May be taken with different content for a total of 6 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 5414:

Topics in Cultural History and Theory

A variable content course exploring the intersection of cultural theory and the discipline of history. Introduces important theoretical contributions to the study of culture and examines how historians have used these constructs to interpret the past. May be taken with different content for a total of 6 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 5464:

Critical Security Studies

Provides an overview of the critical study of security in world politics. Introduces alternative conceptualizations of security to the military-focused, state-centric security/strategic studies. Considers constructivist, post-structuralist and critical theoretic attempts to conceptualize the nature of security. Compares and contrasts these approaches with widely-accepted understandings of security in light of key debates in contemporary security studies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5444 OR PSCI 5444 (UG)

Corequisite(s):

ASPT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

ASPT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ASPT 6004:

Topics Interdisciplinary Perspectives in Soc, Pol, Ethical, & Cultura Thgt

Topical seminar devoted to a significant problem in social, political, ethical and cultural thought. Integrates readings reflective of those four domains and is taught by an interdisciplinary team with research expertise in the particular problem addressed by the course. Via their substantive focus and advanced theory orientation, the seminar topics also offer comparative exposure to the ontologies and epistemologies embedded in disciplinary frameworks. Linked to a speaker series integrated with the course. May be repeated for a maximum of 9 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 6014 (GIA 6204) (PSCI 6204):

Theories of Globalization

Examination of past and present eras of globalization through various theoretical perspectives. Addresses colonialism and emergence of western models for development of poor countries. Controversies about impacts of current globalization on the nation-state, cultures, ecosystems, and racial/ethnic/gender inequalities. Explores present trends, such as globalization of agriculture and food systems, industrial production, migration, human rights, and anti-globalization resistance. Prerequisite may be substituted for any equivalent 5000 level international course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GIA 5264 OR UAP 5264

Corequisite(s):

ASPT 6024:

Contemporary Religious Thought

Concentrates on a selected major figure in religious thought in relation to contemporary society, politics, ethics, and culture. May be repeated up to five times with different content. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 6104:

Interdisciplinary Perspectives in Methodology

Addresses problems of methodology that face researchers pursuing theoretically informed interdisciplinary research involving words, objects, and images. Provides exposure to disciplinary based and interdisciplinary methodologies. Emphasis on the methodological complexities of working in tandem with varied objects of analysis in theoretical and practical terms. Graduate standing and prior completion of an approved disciplinary based methodology course required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 6204:

Topics of Indisciplinary Frameworks in Soc, Pol, Cultural & Ethical Thgt

Topical seminar devoted to a significant problem in social, political, ethical and cultural thought. Integrates readings reflective of at least two of the four bodies of thought and theory addressed by ASPECT. Offers problem-centered, advanced exposure to interdisciplinary work. Team taught by two instructors with research expertise in the particular topic. May be repeated for a maximum of 9 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 6224 (PHIL 6224):

Distributive Justice

Influential contemporary theories of distributive justice. Social, political, ethical, and cultural dimensions of distributive questions. Utilitarianism, liberalism, libertarianism, pluralism, multiculturalism, autonomy, rights, needs, (global) egalitarianism, and (global) poverty. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 6904:

ASPECT Professional Development

Preparation for successful completion of the interdisciplinary Ph.D. and for post-doctoral professional roles. Assists Ph.D. students in proposal preparation, identifying funding ASPECT related research, determining publication outlets and manuscript preparation requirements, and conference paper guidelines and presentation. Graduate standing in ASPECT doctoral program required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ASPT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ANIMAL AND POULTRY SCIENCES

David Gerrard, Head

Professors: Mark Cline; Alan Ealy; Mark Estienne; David Gerrard; Elizabeth Gilbert; Scott Greiner; Honglin Jiang; Sally Johnson; James Knight; Michael Persia; Robert Rhoads; Edward Smith; Eric Wong;

Associate Professors: Fernando Biase; Susan Campbell; Samer El-Kadi; Dan Eversole; Erica Feuerbacher; Leonie Jacobs; Timothy Jarome; Vitor Mercadante; Gota Morota; Michelle Rhoads; Robin White; Cynthia Wood;

Assistant Professors: Azahar Ali; Chun-Peng Chen;

John W. Hancock, Jr., Professor of Animal Science: Eric Wong;

Paul Mellon Distinguished Chair of Agriculture: Sally Johnson;

Graduate Contact: sashas5@vt.edu

Student Handbook: http://www.apsc.vt.edu

The Department of Animal and Poultry Sciences at Virginia Tech offers the M.S. and Ph.D. degrees. Students may specialize in the areas of genetics, genomics, immunology, management, muscle biology, nutrition, physiology, and product quality assurance. Interdisciplinary and interdepartmental programs are encouraged and students are given wide latitude to develop customized programs of study directed toward specific career goals. The department has 32 faculty members who serve the needs of about 600 undergraduate and about 60 graduate students.

SPECIAL FACILITIES

State of the art laboratories supporting all areas of graduate research are located in Litton Reaves on campus. Biosafety Level 2 animal research laboratories also are located in the building. The well-equipped laboratories offer expertise in microscopy, molecular biology, chromatography, protein chemistry and body composition (DEXA). Collaborations and partnerships with the Virginia-Maryland College of Veterinary Medicine foster access to additional animal expertise and equipment. The Department of Animal and Poultry Sciences actively disseminates information through regional meetings and national and international symposiums and conferences. An integral component of the graduate student experience is participation in these venues.

Facilities

Animal Research Facilities The Department manages six livestock and poultry centers on-campus and at nearby Kentland Farm and the Virginia Tech Meat Science Center. These include Poultry research centers with hatcheries, grower barns, a processing facility and a feed mill for the support and management of large chicken and turkey flocks. Barns and working facilities for the management of a 300-cow beef herd. Paddocks, pastures and stalls that house a riding herd of 40 horses and a research and teaching herd of an equal number. Farrow to finish barns that support a 70-sow swine herd. Copenhaver Sheep Center is home to 200 ewes for teaching and research. Environmental and metabolism labs capable of supporting BSL2 research in livestock and poultry are available. The Department maintains an equine exercise performance laboratory with nutrition and pasture management facilities at the Middleburg Agriculture Research and Extension Center. The historical Kentland Plantation, 20 miles from campus, provides resources for grazing and animal research. The Shenandoah Valley and Southwest Virginia Agricultural Research and Extension Centers, each 100 miles from campus, provide additional resources for beef cattle forage nutrition and management. The Tidewater Agricultural Research and Extension Center in Suffolk supports an active off-campus program in swine research and extension. Laboratory facilities In addition to the state of the art equipment located in Litton Reaves, University supported proteomic, genomic and bioinformatics core facilities are available to our faculty and students.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal (150.0), Quantitative (150.0)

Master's Degree. The Department of Animal and Poultry Sciences allows for both thesis and non-thesis master's degrees. Minimum total graduate credits (5000-level or higher) for thesis option: 30; minimum research credits: 6; minimum graded credit hours: 20. The non-thesis option must include Project and Report: 6 hours minimum; minimum graded graduate credits for non-thesis option: 24. Seminars: minimum 1.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal (150.0), Quantitative (150.0)

PhD Degree. Each Ph.D. student must complete a minimum of 90 credit hours of graduate study and a dissertation. Minimum Research and Dissertation hours: 30. Minimum 5000-level or higher graded courses: 27. Seminars: minimum 2.Follow Graduate Catalog procedures.

GRADUATE COURSES (APSC)

APSC 5004:

Graduate Seminar

Students review and lead discussion of current problems and literature in Animal and Poultry Sciences. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5014:

Professional Development of Graduate Students

Provides graduate students training and experiences to develop professional expertise as scholars, scientists and industry professionals. Scientific method in the development of graduate research, time management, self-reflection, analysis and assessment, integrating research and teaching, ethical conduct in research and teaching, research integrity, ethical writing and avoiding plagiarism, applying critical thinking to research and teaching, professional scientific presentations, training and certification (including IACUC and new VT-specific EHS Biosafety for Research Labs). Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5114:

Advanced Ruminant Nutrition and Feeding

Advanced aspects of ruminant digestion, fluxes of nutrients, biological endpoints, microbial fermentation, absorption, metabolism, physiology, and the integration of these processes into ration formulation for health, productive, and environmental objectives. Evaluation of research techniques and models used in ruminant nutrition. Pre: ALS 5116.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ALS 5116

Corequisite(s):

APSC 5134:

Applied Behavior Analysis for Animal Behaviorists

Applied behavior analysis and behaviorism as applied to animals. Pavlovian and operant conditioning principles to applied settings with animals, including domestic animal training and behavior consultations, captive exotic behavioral husbandry and training. Environmental manipulations including antecedent events and consequences to effect desirable behavior change. Functional relations to determine environmental causes of behavior. Common training practices in the context of evidence-based principles. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5154:

Behavioral Biology of Domesticated Animals

Behavioral biology of domesticated animals. Biological underpinnings of behavior explored through fields of neurobiology, endocrinology, behavioral genetics, epigenetics, and population genetics. Specific processes that affect development of personality (intrauterine effects, maternal care, socialization, trauma). Domestication from anthropological, biological, and genetic perspectives. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5164:

Ethology & Applied Ethology of Domesticated Animals

History and context of ethology and applied ethology. Basic concepts and central subjects for understanding the biological bases of animal behavior (e.g., behavioral evolution, social behavior and communication). Process of domestication as it pertains to the behavior of present-day domestic animals (e.g., livestock and companion animals). Development of problem behavior in domestic animals and the influence of environmental factors on behavior. Impact of morphology on behavior. Applications of learning principles and applied ethology to assess and improve the behavior and welfare of animals. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5184:

Research Methods for Animal Behaviorists

Research methods and data analysis. Designs relevant to applied animal behavior. Considerations for choosing a research design, hypothesis testing, choosing and defining variables, and collection methods. Single-subject research designs, including reversal, multiple baseline, multielement, and parametric. Data-based research decisions. Group designs, including factorial, nested, and parametric. Visual representation and analysis of data. Descriptive statistics and introduction to basic parametric and nonparametric statistical tests. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5234:

Applications of Applied Animal Behavior

Applications of behavioral principles to practical animal behavior and welfare scenarios, focusing on companion animals with additional examples from equine, exotic, and livestock domains. Behavior plan creation and assessment for different behavioral issues using basic principles learned in APSC 5134. Survey of currently utilized behavioral treatments and analysis of these into their behavioral principle components, along with efficacy assessment, possible behavioral side-effects and challenges in implementation. Ethical considerations for intervention choices, and standards for practitioners. Effective training of owners, handlers, staff or others involved in behavior plan implementation based on evidence-based best practices.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): APSC 5134

Corequisite(s):

APSC 5244:

Applied Equine Behavior

Principles of learning and ethology and behavior plans for equine stable management, routine handling, and training. Causes of unwanted, unsafe, and abnormal equine behavior, and interventions based on evidence-based practices. Analysis of current practices and best practices to equine training and management. Ethical and professional standards for training and behavior intervention.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): APSC 5134

Corequisite(s):

APSC 5254:

Managed Animal Ethology & Welfare

Animal welfare from holistic frameworks. Assessing physical and mental health. Philosophical frameworks and practical assessment of animal welfare. Ethology as a tool for assessing welfare in companion, working, and shelter animals such as horses, cats, and dogs; and other managed populations such as community animals. Data-based interventions, focusing on enrichment and interventions of behavioral change, to improve both immediate and distal welfare.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): APSC 5154

Corequisite(s):

APSC 5264:

Animal Cognition

Applications of behavioral principles and welfare scenarios. Focus on companion animals with examples from equine, exotic, and livestock. Behavior plan creation, assessment for behavioral principles, survey of

behavioral treatments and analysis. Assessment, behavioral side effects and challenges in implementation. Ethical considerations for intervention, standards for practitioners. Training in behavior plan implementation. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

APSC 5334:

Adjunctive Approaches to Behavior Change in Animals

Animal behavior influences beyond behavioral principles. Nutritional and microbiome impacts on behavior. Nutraceutical, and pre- and probiotic impacts on behavior. Basic behavioral pharmacology and options for behavioral medications. Pain management as it pertains to behavioral issues. Diseases that manifest as behavioral issues.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): APSC 5154
Corequisite(s):

APSC 5374:

Animal Behavior Consulting

Approaches to animal behavior consulting. Procedural and policy components necessary for effective consulting. Processes for safely assessing behavior, developing interventions, and measuring outcomes. Ethical treatment development, implementation, and documentation. Mental health considerations for behavior professionals.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): APSC 5134
Corequisite(s):

APSC 5404:

Reproductive Technologies in Cattle

Reproductive principles and techniques in dairy and beef cattle. General bovine reproductive anatomy and physiology, conventional and novel reproductive management schemes, pregnancy diagnosis, cow health concerns, nutritional considerations, environmental influences on reproductive potential, and emerging reproductive technologies.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

APSC 5444:

Contemp Issues Reprod Biology

Current reproductive biology issues and research literature. Physiological, molecular and cellular processes in reproduction. Formulation of hypotheses in new and emerging areas of reproductive biology, including central nervous system control of reproduction, gametogenesis, ovarian physiology, early embryogenesis, uterine function, placental biology, fetal programming, assisted reproductive technologies, stem cell biology and emerging topics in reproductive biology. Principles of teamwork in research on reproductive biology.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

APSC 5514G:

Advanced Animal Growth and Development

Meat animal growth and development processes, micro and gross anatomy, stem cell biology and growth, body and carcass composition with application to animal and carcass evaluation. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

APSC 5524:

Advanced Muscle Biology

Core concepts underlying developmental myogenesis, metabolic demands and transcriptional control of adult skeletal muscle biology, biochemistry and physiology. Integration of inter/intracellular signaling processes into muscle homeostasis, exercise, disease and repair.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ALS 5304

Corequisite(s):

APSC 5554:

Mammal Genome Biology

Mammal genome biology including structure of DNA and various modifications of DNA, including epigenetic modifications such as methylation and acetylation, and artificial modification of the genome using various genome editing technologies. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5604:

Writing Effective Fellowship Grant Applications

Typical requirements, content, and structure of predoctoral fellowship grants and how the grant review process works. Critical review and effective presentation of research grants. Course combines lectures with discussion of example grants. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5894:

Final Examination

For non-thesis candidates who are required to register for their final examination and have completed their program of study. Not to be included in minimum hours required for degree.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5904:

Project and Report

Project for non-thesis Master of Science degree. To constitute a maximum of 6 of the 45 hours required for the degree. May be repeated.

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

APSC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI, VI1

Instruction Type(s): Independent Study, VI, VI1

Prerequisite(s):

Corequisite(s):

APSC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

APSC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

APSC 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ARCHITECTURE

James Bassett, Interim Head
Aki Ishida, Associate Head

Emeriti Faculty: Salahuddin Choudhury; Humberto Rodriguez-Camilloni; Hans Rott; Robert Schubert; Steven Thompson;

Professors: Kathryn Albright; Aaron Betsky; Markus Breitschmid; Terry Clements; Donna Dunay; Robert Dunay; Paul Emmons; Michael Ermann; James Jones; Mintai Kim; Susan Piedmont-Palladino; Mehdi Setareh; Marcelo Stamm; Frank Weiner; Joseph Wheeler; Henri de Hahn;

Associate Professors: James Bassett; Edward Becker; Joseph Bedford; Hilary Bryon; Patrick Doan; David Dugas; Kay Edge; Marcia Feuerstein; William Galloway; Howard Gartner; Ronald Gibbons; William Green; Aki Ishida; Paul Kelsch; Brook Kennedy; Shelley Martin; Margarita McGrath; Vance Pittman; Heinrich Schnoedt; Gregory Tew; Sharone Tomer; Elif Tural; Brad Whitney; Paola Zellner Bassett;

Assistant Professors: Stefan Al; Yoon Jung Choi; Eiman Elgewely; Jaeyoung Ha; Jonas Hauptman; Jonathan King; Shaun Rosier; Jennifer Thomas; Mehmedalp Tural; Yaoyi Zhou;

G. Truman Ward Endowed Professor in Architecture: Donna Dunay;

T.A. Carter Professor in Architecture: Robert Dunay;

Patrick and Nancy Lathrop Professor: Paul Emmons;

Associate Professor of Practice: Kevin Jones; Martha Sullivan;

Professor of Practice: Enrique Ruiz Geli;

Collegiate Associate Professors: Ryan Pieper; Christopher Pritchett;

Assistant Professor of Practice: Luis Borunda Monsivais; Deidre Regan; Miranda Shugars;

Adjunct Faculty: David Lever;

Graduate Coordinator: vaughnw@vt.edu

School of Architecture + Design: http://archdesign.vt.edu/architecture/

Master of Architecture The graduate curriculum is structured to allow flexibility and to accommodate diverse student needs. This is accomplished by offering a combination of choices of studies available within the various program options. The M.Arch. 2 and 3 options result in the conferring of a first professional degree, fully accredited by the National Architectural Accrediting Board. For details see http://archdesign.vt.edu/architecture/Central to the academic structure of these several options is the design laboratory. The various design laboratories are oriented toward formulation and resolution of design questions at a broad range of scales. In addition to fostering a mastery of the design process, the design laboratory is intended to cultivate a foundation for design through the study of concepts and principles of form generation, through education of an environmental awareness and aesthetic judgment, through study of the syntax of architectural language, and through the development of technical knowledge of the processes of fabrication and construction. These learning-oriented laboratories encourage the use of previously acquired knowledge, skills, and experience gained in the architectural profession and in other academic disciplines.

SPECIAL FACILITIES

The Architecture programs are housed on the Blacksburg campus in Cowgill Hall and Burchard Hall and are supported by research shop facilities located at the Research and Demonstration Facility and the Advanced Design and Construction Facility. The Washington Alexandria Architecture Center [WAAC] is located in historic old town Alexandria, Virginia and is a part of the university's National Capital Region facilities. Most program options are offered at the WAAC except the M.Arch 3 option. Students may also elect to spend a semester of study abroad at the university's Steger Center for International Scholarship in Riva San Vitale, Switzerland where we have a residential studio each spring.

Advanced Design and Construction Facility

The Advanced Design and Construction facility is a new 5,000 square foot building scheduled for occupancy Spring of 2019. Situated adjacent to the Research and Demonstration Facility in the Plantation Road Research complex, this laboratory is an integral part of academic and research programs, supporting building prototype construction and testing at a range of scales from components through full-scale building assemblies. This flexible laboratory is outfitted with an overhead gantry crane and a wide complement of state-of-the-art computer-aided fabrication tools. Intelligent buildings, advanced material research, and robotic-assisted assembly with an emphasis on testing and evaluation are among the types of projects taking place here.

Burchard Hall

Burchard Hall provides studio space for the architecture and industrial design programs of the School of Architecture + Design, faculty office space, and workshops for ceramics, plaster, graphics, and computer/digital media. The building was constructed underground -- with four pyramidal skylights illuminating studio spaces below -- to preserve Cowgill Plaza, a popular meeting place and campus thoroughfare. A stairway leads from a kiosk in the plaza to the subterranean offices and studio space.

Cowgill Hall

Cowgill Hall houses the School of Architecture + Design administrative offices, as well as the College of Architecture and Urban Studies Dean's offices. In addition, it provides space for faculty offices, classrooms, and undergraduate and graduate architecture studios. The lobby of Cowgill Hall serves as the school's principal exhibition space. Literature resources are also housed on the ground floor of Cowgill Hall in the Art and Architecture Library, a branch of the University's Newman Library. Shop facilities, located adjacent to the building, provide woodworking and metalworking equipment; a ceramic workshop allows creative and analytical work with clay and plaster; a graphics workshop includes equipment for etching, embossing, and serigraphy; and there are five darkrooms plus film, video, and other photographic facilities.

Research and Demonstration Facility

Located at the end of Plantation Road, approx. 1 mile from the center of the Virginia Tech campus in Blacksburg, the Research + Demonstration Facility provides approximately 11,000 square feet of space, including a design studio, a seminar/lecture room, workshops, a testing facility for wall constructions, and testing laboratories for indoor air quality. Since its dedication in the Spring of 1994, the Research and Demonstration Facility, built through a series of construction research projects sponsored by the National Concrete Masonry Association and other industry groups, has become an integral part of the School's academic and research programs, supporting prototype construction and testing at a range of scales from components through full-scale building assemblies. The surrounding University-owned land is suitable and available for the construction of building prototypes for testing in an exterior environment.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

Master of Science in Architecture (offered in Blacksburg and at the Washington Alexandria Architecture Center in the NCR)The Master of Science in Architecture program offers the opportunity for advanced study and research in specialized areas related to building design, construction, and operations over a broad range of scales, providing the basis for diverse career paths and/or entry into a Ph.D.- level program. The M.S. is not directed toward professional licensing and therefore is not accredited by the NAAB as a "first professional degree." While an undergraduate degree in architecture or a related field is not required, applicants must demonstrate relevant background and experience, as well as capabilities for undertaking advanced academic study.The Master of Science program allows a student to conduct a research-based program of study which can be expected to contribute to the body of knowledge in the design and building professions, and may lead to future study in the doctoral program, where advanced standing may be awarded for acceptable graduate credits earned at the master's level.Students will develop their own programs of study in cooperation with appropriate faculty and in consideration of the courses and facilities available. A brief description of the available research concentrations follows: Building Science: Studies in the category of Building Science focus on various issues over a broad range of scales and may concentrate on the following (or other) areas: energy and building design; mechanical systems and large buildings; lighting and day-lighting; natural ventilation and air flow; indoor air quality; acoustics and theater design; and building structure, assembly, and/or economics. Interior Design: This concentration allows those with professional degrees in Interior Design or closely related areas the opportunity for advanced research which is expected to add to the body of knowledge in the discipline of Interior Design. Potential research areas include design practice, history of interiors, computer applications in interior design, and environmental factors related to interiors. Urban Design: This concentration allows students an opportunity to engage in urban design research, addressing the design of safe, healthy, and sustainable urban environments. Emphasis is on the physical form of cities and the complex forces that shape them. Focused on the general underlying themes of security, resilience, health, and sustainability, possible research areas include but are not limited to mobility and infrastructure, conservation and preservation, and urban places and dwellings. The Urban Design program is housed in the facilities of the Washington - Alexandria Architecture Center in Alexandria, VA (Greater Washington Metro Area). History and Theory: Studies in this concentration examine the works, artefacts and ideas of architects, historians, theorists and educators to inform a deeper understanding of contemporary issues in architecture. Includes reading in related fields such as philosophy, histories of art, literature and science and technology studies to reconsider and critique forms of knowledge, practice and pedagogy in architecture culture. Available at both the main campus (Blacksburg) and the Washington-Alexandria Architecture Center (Greater Washington Metro Area). The Master of Science degree is awarded upon satisfactory completion of an approved plan of study of at least 36 credit hours, normally including a thesis representing up to 10 hours of the total hours required.

MArch Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

Master of Architecture (offered in Blacksburg and at the Washington Alexandria Architecture Center in the NCR for all or a portion of the of the degree) First Professional Degree ProgramsM.Arch.2, Advanced Professional Studies:An Advanced Professional Studies option (M.Arch.2) is offered for the student who has previously obtained a four-year, pre-professional baccalaureate degree in architecture. The first year of study continues the student's professional building design education and related technical and history/theory studies. The second year is reserved for preparation of a design thesis demonstrative of the student's academic accomplishment and professional potential. Students in this program typically complete 54 (min.) credit hours, normally requiring at least two academic years (four semesters) of study. Students in the M.Arch.2 program may elect to enroll at the Washington-Alexandria Center for all or a portion of their required studies and/or may spend a semester participating in the Europe Study Abroad Travel Program or in residence at the Center for European Studies and Architecture (CESA) in Riva San Vitale, Switzerland.M.Arch.3, Comprehensive Professional StudiesA Comprehensive Professional Studies option (M.Arch.3) is provided for graduate applicants with degrees in fields other than architecture. The student is presumed to have undertaken little or no concentration in architecture prior to enrollment in the program. In addition to the 54 (min.) graduate credit hours required for the degree, students in the M.Arch.3 option complete 27 credit hours of qualifying year academic work, engaging in studies to provide a foundation of environmental design experiences and to promote a basic understanding of the discipline. Upon successful completion of the qualifying year, students advance through a sequence of studies providing for development of building design skills and knowledge of building systems and the technical processes of construction. During the final year of the curriculum, students pursue individual study interests and prepare a thesis. This program usually requires at least three and one half years (three academic years, plus one required summer) of study. Students in the M.Arch.3 program may elect to enroll at the Washington-Alexandria Center for the final, thesis year and/or may spend a semester participating in the Europe Study Abroad Travel Program or in residence at the Center for European Studies and Architecture (CESA) in Riva San Vitale, Switzerland. Accredited degrees:The M.Arch.2 and M.Arch.3 programs are fully accredited by the National Architectural Accrediting Board as first professional degree programs in architecture.In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit US professional degree programs in architecture, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted a 6-year, 3-year, or 2-year term of accreditation, depending on the extent of its conformance with established educational standards.Masters degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree that, when earned sequentially, constitute an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree.

GRADUATE COURSES (ARCH)

ARCH 5036:

Advanced Environmental Controls

Advanced studies of environmental controls, the system, and its physical environmental factors, including development in building systems, urban systems, service systems, construction systems, materials and component systems, psycho-physical consideration, systems analysis, and computer technology. May be repeated for a maximum of 12 credit hours in varied options offered.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):   ARCH 4755 (UG), ARCH 4756 (UG)

Corequisite(s):

ARCH 5044G:

Professional Practice

Introduction to scope and diversity of the building enterprise, addressing private and public macroeconomic, industrial, technical, professional, and regulatory institutions. Analysis of historic evaluation of professional roles and practices; emergence of new modes of practice, including innovative facilities procurement methods. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5045:

Environmental Design Research

Methods for identifying, evaluating, and enhancing the knowledge base for design decisions at scales ranging from room to region. Course emphasizes analytic and empirical approaches to characterizing attributes of the physical environments and their transformation into design variables. Sources of emerging knowledge and systems for maintaining technical currency are identified. Bachelors Degree in Environmental Design (B.S. Arch, B. Arch, B.L. Arch) required. Co: UAP 5495 or UAP 5496 or EDAE 5300.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5056:

Advanced Building Structures

Study of building forms and structure systems ranging from horizontal-span structures to skyscrapers; preliminary design of masonry buildings, skeletons, tubes, soft and rigid surface structures by considering the complexity of load action that includes wind, seismic, and hidden loads.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   ARCH 4775 (UG), ARCH 4776 (UG)

Corequisite(s):

ARCH 5064:

Topics in Computer Applications in Design

Computer system fundamentals. Introduction to programming. Emphasis on computer graphics in 2 and 3-space geometry and graphics-related topics employing several languages. Computer usage in architectural design and production. Exploration of available hard and software through advanced design issues. May be repeated for a maximum of 12 credit hours with different content or topics.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s): ARCH 4716 (UG)
Corequisite(s):

ARCH 5115:

Media and the Environment Workshop

The role of various media of visual communication as tools of documentation, analysis, and creation in the designed visual environment. Skills in photography, film, video techniques, and printmaking graphics will be developed in specific relation to environmental design study and presentation.

Credit Hour(s): 3
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): ARCH 5715, ARCH 5716, ARCH 5994

ARCH 5116:

Media and the Environment Workshop

The role of various media of visual communication as tools of documentation, analysis, and creation in the designed visual environment. Skills in photography, film, video techniques, and printmaking graphics will be developed in specific relation to environmental design study and presentation.

Credit Hour(s): 3
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): ARCH 5715, ARCH 5716, ARCH 5994

ARCH 5125:

Materials Processes Workshop

Characteristics, properties, and uses of various materials and processes as tools of study, analysis, and presentation of the designed environment. The proportion, form, and sectional analysis of hand, wheel, and cast objects are studied. Uses of these materials and the technical process involved are emphasized. Workshop provides framework for design of small scale objects which can relate to environmental design and larger urban scale issues. Co: 5705, 5706 or 5994

Credit Hour(s): 3
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): ARCH 5705

ARCH 5126:

Materials Processes Workshop

Characteristics, properties, and uses of various materials and processes as tools of study, analysis, and presentation of the designed environment. The proportion, form, and sectional analysis of hand, wheel, and cast objects are studied. Uses of these materials and the technical process involved are emphasized. Workshop provides framework for design of small scale objects which can relate to environmental design and larger urban scale issues. Co: 5705, 5706 or 5994.

Credit Hour(s): 3
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): ARCH 5706

ARCH 5134:

Topics in Architecture History and Theory

Study and critical evaluation of selected current and historical issues in architecture and environmental design. Materials studied will be in the form of projects and writings of key designers, interpretations by leading critics and analysis by historians. Topics will be selected from such areas as: theories of change in culture and architecture; concepts of expression, image, symbol, and form; problems of functional, rational, and social analysis; perception of space and organization. May be repeated for a maximum of 12 credit hours in varied options offered.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ARCH 5434:

Advanced Architectural Lighting Design

Advanced level lecture course focused on lighting. Impact on, need for and measurement of light for humans and the built environment. Selection of light sources, equipment and controls. Daylight integration. Lighting design, visualization and calculations through hand and digital methods for multi-functional and multi-user indoor and outdoor spaces. Evaluation of lighting system energy efficiency and cost. Presentation of lighting design Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5515:

Arch & Systems Lab

Architecture design laboratory with concentration on development of intellectual and professional skills of analysis, synthesis, and evaluation in design problem solving. Focus on the interrelatedness of the various components of building structure and enclosure, integration of building environmental controls, and the contribution of materials and methods of construction to the design process.

Credit Hour(s): 6

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): ARCH 4716 (UG)

Corequisite(s):

ARCH 5516:

Arch & Systems Lab

Architecture design laboratory with concentration on development of intellectual and professional skills of analysis, synthesis, and evaluation in design problem solving. Focus on the interrelatedness of the various components of building structure and enclosure, integration of building environmental controls, and the contribution of materials and methods of construction to the design process.

Credit Hour(s): 6

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): ARCH 4716 (UG)

Corequisite(s):

ARCH 5565:

Building Materials and Construction

Building materials, elements, and construction methods, including wood, masonry, concrete, and steel construction, building foundations and sitework, building and zoning codes, building cost considerations, interior finishes, and building envelope systems, including cladding, windows and window walls, curtain walls, roofing, and insulation; emphasis on knowledge of building materials and construction methods in support of architectural design decisions; historical development of building materials and ways of building, standard building practice, and analysis of the construction of significant works of architecture. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5566:

Building Materials and Construction

Building materials, elements, and construction methods, including wood, masonry, concrete, and steel construction, building foundations and sitework, building and zoning codes, building cost considerations, interior finishes, and building envelope systems, including cladding, windows and window walls, curtain walls, roofing, and insulation emphasis on knowledge of building materials and construction methods in support of architectural design decisions; historical development of building materials and ways of building, standard building practice, and analysis of the construction of significant works of architecture. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5614:

Theory of Urban Form

Urban forms related to functions; analysis of socioeconomic, political, historical, geographic, and cultural forces influencing urban form. Concepts of idealized urban forms and theoretical models of urban configuration.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ARCH 4705 (UG)

Corequisite(s):

ARCH 5624 (UAP 5624):

Urban Design Seminar

Current topics in urban design. Topics may include: theoretical, conceptual and practical concerns in the generation of urban spatial form; the roles of public and private interests in shaping urban form; the effects of urban intensification on the quality of public spaces; environmental issues in urban design; the role of public policy and

regulatory mechanisms; the genesis and development of urban typologies. Each seminar will address one of these or related subject areas. Course may be repeated with a different subject for a maximum of 12 credits.
Credit Hour(s): 1 TO 3
Lecture Hour(s): 1 TO 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ARCH 5614 (UG)
Corequisite(s):

ARCH 5644:

Comparative Urbanism Seminar

Explores current issues, situations, and developments in diverse urban settlements across cultures. Direct experience of selected cities will be supported by contemporary and historic readings, maps and drawings to illuminate differential technological, environmental, economic, social and cultural forces shaping subject cities. Research methods applicable to urban design will be discussed. Choice of cities and areas of focus will be determined by students based on their thesis research proposals. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ARCH 5705:

Architecture and Urbanism Seminar

Review of contemporary concepts in architectural design in the context of the urban environment. Significant architectural works of the twentieth century and the theories of their authors will be studied for an understanding of their contribution to the language of architecture. The attitudes and phenomena which have led to the making of the particular culture of our time will be studied for their impact on the built urban environment.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ARCH 5516 (UG)
Corequisite(s):

ARCH 5706:

Architecture and Urbanism Seminar

Review of contemporary concepts in architectural design in the context of the urban environment. Significant architectural works of the twentieth century and the theories of their authors will be studied for an understanding of their contribution to the language of architecture. The attitudes and phenomena which have led to the making of the particular culture of our time will be studied for their impact on the built urban environment.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ARCH 5516 (UG)
Corequisite(s):

ARCH 5715:

Architecture and Urbanism Laboratory

Advanced design laboratory for identifying needs, resources and operational methodologies across an expanded range of environmental scales. The scope of design includes the relation of the individual building to the environment in comprehensive terms, with particular emphasis on the complexity which exists at the urban scale. Methods for the identification of socio-cultural needs and the coordination of complex variables, information, and resources, leading to the conceptualization and development of design of the components of the built environment.
Credit Hour(s): 6
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s):
Corequisite(s):

ARCH 5716:

Architecture and Urbanism Laboratory

Advanced design laboratory for identifying needs, resources and operational methodologies across an expanded range of environmental scales. The scope of design includes the relation of the individual building to the environment in comprehensive terms, with particular emphasis on the complexity which exists at the urban scale. Methods for the identification of socio-cultural needs and the coordination of complex variables, information, and resources, leading to the conceptualization and development of design of the components of the built environment.
Credit Hour(s): 6
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s):
Corequisite(s):

ARCH 5755:

Advanced Design Laboratory

Complex environmental design problems related to social, cultural, and historical issues examined for contribution to developing appropriate architectural form and aesthetic. Laboratory will focus on research and development of graduate design projects at a range of scales: product, architectural, urban; based on individual interests.

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Lab, VB

Instruction Type(s): Lab, VB

Prerequisite(s): ARCH 4716 (UG)

Corequisite(s):

ARCH 5755G:

Building Environmental Systems

A design oriented study of environmental forces, environmental impacts of the built environment, and related building environmental control, life safety and service systems, with concern for the human psycho-physical impacts of building form and system performance. Prerequisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ARCH 4706 (UG)

Corequisite(s):

ARCH 5756:

Advanced Design Laboratory

Complex environmental design problems related to social, cultural, and historical issues examined for contribution to developing appropriate architectural form and aesthetic. Laboratory will focus on research and development of graduate design projects at a range of scales: product, architectural, urban; based on individual interests.

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Lab, VB

Instruction Type(s): Lab, VB

Prerequisite(s): ARCH 4716 (UG)

Corequisite(s):

ARCH 5775G:

Intermediate Bldg Structures

Building structures in steel, timber and reinforced concrete; design of typical components: beams, slabs, columns, beam-columns, connections, and foundations: design of retaining walls; the resistance of buildings to gravity and lateral force action; building stability; floor/roof framing systems; design of simple buildings. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 3704 (UG)

Corequisite(s):

ARCH 5776G:

Intermediate Bldg Systems

Building structures in steel, timber and reinforced concrete; design of typical components; beams, slabs, columns, beam-columns, connections, and foundations; design of retaining walls; the resistance of buildings to gravity and lateral force action; building stability; floor/roof framing systems; design of simple buildings. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 3704 (UG)

Corequisite(s):

ARCH 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ARCH 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI, VI1

Instruction Type(s): Independent Study, VI, VI1

Prerequisite(s):

Corequisite(s):

ARCH 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ARCH 6005:

Movements in Architecture and Western Thought

Platform for advanced studies in the historic and canonic evidence of the objective reality of architecture. Establishes a basis on which an emerging designer can build for future work and inquiry. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 6006:

Movements in Architecture and Western Thought

Platform for advanced studies in the historic and canonic evidence of the objective reality of architecture. Establishes a basic on which an emerging designer can build for future work and inquiry. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ARCH 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ARCHITECTURE AND DESIGN RESEARCH

James Bassett, Interim Program Director

Emeriti Faculty: Dean Bork; Brian Katen; Patrick Miller; Humberto Rodriguez-Camilloni;

Professors: Markus Breitschmid; Paul Emmons; James Jones; Mehdi Setareh;

Associate Professors: Hilary Bryon; Terry Clements; Marcia Feuerstein; Paul Kelsch; Mintai Kim;

Adjunct Faculty: David Lever;

Graduate Coordinator: vaughnw@vt.edu

Graduate Chair: kedge@vt.edu

Blacksburg Program: wolverine@vt.edu

Alexandria Program: pemmons@vt.edu

Landscape Architecture Track: mintkim@vt.edu

Interior Design: whitneyb@vt.edu

Blacksburg Program: jbsstt@vt.edu

School of Architecture: http://archdesign.vt.edu/architecture/

Washington Alexandria Achitechture Center: http://www.waac.vt.edu/

Ph.D. in Architecture and Design Research http://archdesign.vt.edu/architecture-design/phdDegree Tracks within the Ph.D. in Architecture and Design ResearchThere are two major tracks within the Architecture and Design Research degree, each of which has topical areas. The requirements for the tracks vary slightly, but both provide significant flexibility for each student to develop a plan of study consistent with his or her academic goals. The two tracks are Architecture and Design Research.Architecture TrackThe Architecture track includes Architectural Representation and Education, Architectural History and Theory, Historic Preservation, and Computing and Representation.The Architecture track will share resources on the Blacksburg Campus and the Washington Alexandria Architecture Center in the National Capital Region. At the latter location, students have the best resources to develop their topics in architectural representation, since they can make use of the many research libraries available in the Washington, DC area, including the Library of Congress, National Building Museum library, American Institute of Architects Library, CASVA, Smithsonian Institution, the Dumbarton Oaks Library and many privately owned architectural archives.Design Research TrackThe Design Research track includes advanced study on Building Science, Industrial Design, Interior Design, and Landscape Architecture. The Landscape Architecture Track includes concentrations in: Design Learning and Professional Paradigms; Regenerative/Ecological Design, Planning and Technology; and Concepts of Community and Place. The Design Research track is currently located in Blacksburg, VA at the Virginia Tech Main Campus. In this location students have the best resources to develop their topics in design research given that the faculty of the School of Architecture Design have established collaborative relationships with other university centers and institutions.AdmissionThe faculty are seeking to admit a highly selective group of students who have master's degrees in closely allied fields, such as Architecture, Environmental Design, Building Science, Landscape Architecture, Architecture History and Theory, Interior Design, and Industrial Design. In addition to the application requirements of the Virginia Tech Graduate School and those pertaining to all graduate programs within the School of Architecture Design, applicants to the PhD degree in Architecture and Design Research must submit a portfolio and a 2,500 word statement of research focus.

SPECIAL FACILITIES

Washington - Alexandria Architecture Center in the Virginia Tech National Capital Region (Architecture track) Cowgill Hall, Virginia Tech Blacksburg Campus (Design Research track in Building Science and Industrial Design) Burruss Hall, Virginia Tech Blacksburg Campus (Design Research track Landscape Architecture and Interior Design)

School of Architecture + Design Facilities

Cowgill Hall Art & Architecture Library Burchard Hall Burruss Hall Collegiate Square Studio Research + Demonstration Facility Advanced Design and Construction Facility Washington - Alexandria Architecture Center National Capital Region (NCR) Center for European Studies and Architecture

DEGREES OFFERED

PhD Degree

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Ph.D. in Architecture and Design Research: * The Graduate School requires each Ph.D. student to complete 90 semester hours of graduate study and dissertation. * All students, regardless of area of specialization, are required to complete a sequence of specific Architecture and Design Seminars. A two-semester sequence seminar will focus primarily on epistemology and the nature of discipline and practice of architecture, viewed in the context of architecture and the allied fields. Students will also enroll in a continuing seminar course required every semester of residence. In these seminars, Ph.D. students, the School faculty involved with the graduate program, and possible guests present their own research for critical review and feedback. The Ph.D. students in the Architecture track must also pass a test of reading ability in a foreign language related to their selected topics (native languages and English do not fulfill this requirement). Students who are undertaking Ph.D. studies in landscape architecture should include the following courses in their program of study: ARCH 5045 - Design Research Methodology LAR 5724 - Scholarship in Landscape Architecture EDRE 6605 - Quantitative Research Methods in Education I (or equivalent approved by student's committee). EDRE 6504: Qualitative Methods in Educational Research I (or equivalent approved by student's graduate committee). * In addition, all students must complete a special Research Methods course organized by area of specialization. At the approval of the student's advisory committee the course may be also taken in the other area of specialization or outside of the school.

BIO-INSPIRED BUILDINGS

Emeriti Faculty: Susan Day; Paula Relf;

Professors: Virginia Buechner-Maxwell; Michael Garvin; Ignacio Moore; Rolf Mueller; Georg Reichard; Walid Saad;

Associate Professors: Dwight Bigler; Jonathan Boreyko; Bryan Brown; Amy Brunner; Erica Feuerbacher; Steven Hankey; Farrokh Jazizadeh Karimi; Annie Pearce; Jennifer Russell; Earl Shealy;

Assistant Professors: Xinghua Gao; Frederick Paige;

Associate Professor of Practice: Benjamin Chambers;

General Contact: biobuild@vt.edu

Graduate Site: http://biobuild.mlsoc.vt.edu

This doctoral program answers the pressing societal need for professionals with the interdisciplinary expertise necessary to redefine how we develop buildings, infrastructure, and communities. The emerging fields of bioinspiration, biointegration, and bioinclusivity provide paths towards this objective. A bioinspired built environment capitalizes on the regulative, adaptive, and integrative characteristics of biological systems and incorporates or mimics these features as part of the constructed world. In contrast, a biointegrated built environment situates constructed facilities amidst natural systems to achieve complementarity, with natural systems providing useful services to support human needs and aspirations. Finally, bioinclusive built environments afford integrative habitats for humans and non-humans coexisting together, with the needs and aspirations of both taken into account such that synergies between them can be realized. In doing so, buildings and infrastructure will more optimally respond to changing conditions and expectations – which will make the interdependent built environment more sustainable, parsimonious, and resilient, as well as ecologically integrated. Graduates of the BioBuild program will have an immediate impact in university and industrial settings, and they will change the relationship between the built environment and our planet. We do this by bringing together faculty from departments in CAUS, COE, COS, CVM, CNRE, CALS, and CLAHS to deliver a program that explores the human-constructed world and biological and ecological systems synergistically to discover innovative connections between these disciplines. BioBuild Fellows can receive one year or more of financial support from the program while working toward a degree in one of the departments listed below, or from a doctoral program associated with any BioBuild-affiliated faculty. To receive full consideration for financial support in the following academic year, applications should be submitted by January 15 for fall entry or September 15 for spring entry. Participating Colleges, Departments, and Faculty: College of Agriculture & Life Sciences (CALS) School of Animal Sciences - Erica Feuerbacher College of Architecture, Art, & Design (CAAD) School of Performing Arts - Dwight Bigler College of Engineering (COE) Biomedical Engineering & Mechanics - Jonathan Boreyko Building Construction - Annie Pearce, Georg Reichard Civil and Environmental Engineering - Michael Garvin, Farrokh Jazizadeh, Freddy Paige, Tripp Shealy Construction Engineering & Management - Xinghua Gao Electrical and Computer Engineering - Walid Saad Engineering Education - Ben Chambers Mechanical Engineering - Rolf Mueller College of Science (COS) Biological Sciences - Bryan Brown, Ignacio Moore College of Veterinary Medicine (CVM) Large Animal Clinical Sciences – Virginia Buechner-Maxwell College of Natural Resources and Environment (CNRE) Forest Resources and Environmental Conservation – Amy Brunner College of Liberal Arts and Human Sciences (CLAHS) Urban Affairs & Planning - Steve Hankey For more information please visit our web-site at biobuild.mlsoc.vt.edu or send a general request for information to biobuild@vt.edu.

SPECIAL FACILITIES

Our program involves multiple colleges and departments located in facilities across campus. The program is headquartered in Bishop-Favrao Hall, which was opened in 2007 and includes state-of-the-art classrooms, laboratories, a fully functional Build Lab, meeting rooms, and faculty/student offices. It is also the home of the Myers-Lawson School of Construction and the Department of Building Construction. Additional facilities supporting the program include Derring Hall, Goodwin Hall, Norris Hall, and Patton Hall where faculty from the Department of Biological Sciences, the the Department of Mechanical Engineering, the Department of Biomedical Engineering & Mechanics and the Via Department of Civil & Environmental Engineering have laboratory and office space respectively. BioBuild research is also done outdoors on campus as a living laboratory as well as in surrounding communities, including Blacksburg, Christiansburg, Radford, Montgomery County, Floyd County, Giles County, Salem, and Roanoke.

Facilities

BioBuild is an interdisciplinary program and shares facilities among departments across campus. Our research and learning facilities are located in Bishop-Favrao Hall, Derring Hall, Goodwin Hall, and Patton Hall on campus, as well as outdoors on and off campus and in local communities.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

Students in the Bio-inspired Buildings (BioBuild) program earn their doctoral degree from one of the degree-granting programs in which their BioBuild-affiliated advisor is located. Please see a list of current participating programs in the Program Overview and visit specific programs of interest in the Graduate Catalog to review the requirements for those degree programs. We recommend that you identify specific BioBuild faculty aligned with your research interests and contact them directly to discuss the possibility of enrollment in their home program as a BioBuild student. You may also contact other faculty with relevant research interests who are not listed as current BioBuild affiliate faculty. Please mention the BioBuild program as a possible funding source and encourage these faculty to contact Dr. Annie Pearce (apearce@vt.edu) regarding requirements for BioBuild affiliation.

BIOCHEMISTRY

Peter Kennelly, Interim Head

Professors: Dennis Dean; Peter Kennelly; Timothy Larson; Jianyong Li; Biswarup Mukhopadhyay; Pablo Sobrado; Zhijian Tu; Jinsong Zhu;

Associate Professors: Carla Finkielstein; Richard Helm; Michael Klemba; Florian Schubot; Daniel Slade;

Assistant Professors: Kylie Allen; Anne Brown; Brandon Jutras; Chloe Lahondere; Justin Lemkul; Wei Sun; Clement Vinauger Tella;

Director, Fralin Life Sciences Institute: Dennis Dean;

Graduate Contact: dslade@vt.edu

Graduate Contact: lijones5@vt.edu

Graduate Site: https://www.biochem.vt.edu/Graduate.html

Student Handbook:

https://www.biochem.vt.edu/content/dam/biochem_vt_edu/graduate/graduate-handbooks/Graduatehandbook_2021.pdf

The Graduate Program in the Department of Biochemistry at Virginia Tech prepares students for careers as independent researchers in biochemistry, molecular and cellular biology, biotechnology, and related areas. Training involves a combination of advanced course work, participation in seminars and journal clubs and laboratory research conducted under the guidance of a faculty committee selected by students and their faculty advisors. Incoming students participate in three laboratory research rotations to familiarize themselves with faculty and their research. The department has strengths in microbial pathogenesis and infectious disease, cell signaling, proteomics and molecular modeling. The largest cluster of faculty conducts research on infectious diseases with the ultimate aim of developing novel approaches to disease treatment and prevention. Major milestones for students are completion of an oral qualifying examination, an oral preliminary examination which also requires writing an NSF or NIH-style research proposal, and writing and defense of a research dissertation. Students also present their research at national and international conferences and participate in more informal training opportunities, including university-wide scientific writing and grant proposal preparation workshops. Our students typically complete their Ph.D.s within five years and pursue a variety of careers including positions in academia, industry and state and federal government.

SPECIAL FACILITIES

Biochemistry is just one facet of a large and vibrant life science research enterprise at Virginia Tech. Our faculty study a range of biochemical problems using cutting edge research equipment and facilities. In collaboration with the Fralin Life Science Institute, our department is home to a proteomics and metabolomics facility. Our students also have access to core facilities for confocal microscopy, fermentation, protein purification, DNA sequencing, flow cytometry, real-time PCR, and microarray analysis. Virginia Tech is known for its interdisciplinary graduate training. Research strengths include infectious disease, obesity, microbial pathogenesis, and eukaryotic cell signaling. Biochemistry students and faculty are active in each of these areas. Students also have opportunities to interact with scientists from across the country and around the world through the interdepartmental Virginia Tech Life Sciences seminar series. The individual laboratories within the department are well equipped for modern biochemical, molecular biological, and microbiological research. Available equipment include a comprehensive suite of mass spectrometers for proteomic analyses, standard and microplate fluorometers, stopped-flow spectrometer with fluorescence excitation for rapid kinetic analysis, UV-visible photodiode array spectrophotometer, a robotic workstation for high-throughput screening, real-time PCR thermocyclers, liquid chromatography systems, systems for electronic autoradiography and fluorescent/chemiluminescent imaging, and tissue culture and insect rearing facilities. Numerous shared on-campus resources enhance the research opportunities available to students. These include the Keck Confocal Microscope Facility, the Keck Transgenic Plant Greenhouse, the Fralin Fermentation and Protein Purification Facility, and the Flow Cytometry Core Facility. Access to NMR spectrometers and X-ray diffractometers is available through the Departments of Chemistry and Biological Sciences. The Core Computation and Laboratory Facilities at the Virginia Bioinformatics Institute provide a range of bioinformatic, DNA-sequencing, and genomic/proteomic services. The VT CAVE is a multiperson, room-sized, high-resolution, 3-D video and audio environment that can be used to visualize a wide variety of biological molecules in 3-D space.

Biochemistry Facilities

Our main building is Engle Hall and houses most research active faculty. We also have faculty housed in Fralin Hall and Steger Hall. Our students also have access to core facilities for confocal microscopy, fermentation, protein purification, DNA sequencing, flow cytometry, real-time PCR, and microarray analysis. In collaboration with the Fralin Life Science Institute, our department is home to the center for drug discovery screening laboratory, glycomics, and proteomics and metabolomics facility.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

Doctoral students take a set of core courses and at least two specialized courses within their research track during their first two years. Students also complete laboratory rotations (first year) and seminars (all years). Students are typically funded by the department during the first three semesters of laboratory rotation. Most students will work as a teaching assistant for two of those semesters. Ph.D. candidates must also maintain a cumulative GPA of 3.0 or above in all coursework, and complete the following requirements: - Students must meet all course and research credit hour requirements of the Graduate School. - 27 hours of courses numbered 5000 or higher, may include up to 4 hours of seminar.- Complete a minimum of 90 semester hours of graduate study.- Pass the qualifying examination at the end of the first year. - Pass the preliminary examination at the end of the second year.- Write and successfully defend a research-based dissertation. A complete description of the Academic requirements for Ph.D. Degree is also available in the Graduate Student Handbook (https://www.biochem.vt.edu/content/dam/biochem_vt_edu/graduate/graduate-handbooks/Graduatehandbook_2021.pdf).

MSLFS Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

The Master of Science in Life Sciences merges the efforts of the departments of Biochemistry, Entomology, Food Science and Technology, and Plant Pathology, Plant Physiology, and Weed Science. Students in basic and applied disciplines in the College of Agriculture and Life Sciences share common experiences that prepare them for careers in which interdisciplinary interactions become increasingly valued. At the same time, discipline-specific education and research experience, which characterizes the M.S. in Life Sciences program in each department, prepares students for unique positions and career development. For graduation, students must complete a minimum of 20 graded credit hours and 30 total credit hours. Specific course requirements* include Biometry (STAT 5605) Protein Struct & Fxn (BCHM 5224, 3 hours), Adv Applic in Mol Life Sci (BCHM 5784 , 3 hours) and Research Ethics in Ag & Life Sci (ALS 5324, 1 or 2 hours) . All students must present a seminar and defend a thesis describing the results of their research as a final step for the completion of M.S. degree requirements (a non-thesis MS option is also available).*Substitutions must be approved, in advance, by the student's advisory committee and ratified by the Graduate School. A complete description of the Academic requirements for Masters Degree is also available in the Graduate Student Handbook (https://www.biochem.vt.edu/content/dam/biochem_vt_edu/graduate/graduate-handbooks/Graduatehandbook_2021.pdf).

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

Doctoral students take a set of core courses and at least two specialized courses within their research track during their first two years. Students also complete laboratory rotations (first year) and seminars (all years). Students are typically funded by the department during the first three semesters of laboratory rotation. Most students will work as a teaching assistant for two of those semesters. Ph.D. candidates must also maintain a cumulative GPA of 3.0 or above in all coursework, and complete the following requirements: - Students must meet all course and research credit hour requirements of the Graduate School. - 27 hours of courses numbered 5000 or higher, may include up to 4 hours of seminar.- Complete a minimum of 90 semester hours of graduate study.- Pass the qualifying examination at the end of the first year. - Pass the preliminary examination at the end of the second year.- Write and successfully defend a research-based dissertation. A complete description of the Academic requirements for Ph.D. Degree is also available in the Graduate Student Handbook (https://www.biochem.vt.edu/content/dam/biochem_vt_edu/graduate/graduate-handbooks/Graduatehandbook_2021.pdf).

MSLFS Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

The Master of Science in Life Sciences merges the efforts of the departments of Biochemistry, Entomology, Food Science and Technology, and Plant Pathology, Plant Physiology, and Weed Science. Students in basic and applied disciplines in the College of Agriculture and Life Sciences share common experiences that prepare them for careers in which interdisciplinary interactions become increasingly valued. At the same time, discipline-specific education and research experience, which characterizes the M.S. in Life Sciences program in each department, prepares students for unique positions and career development. For graduation, students must complete a minimum of 20 graded credit hours and 30 total credit hours. Specific course requirements* include Biometry (STAT 5605) Protein Struct & Fxn (BCHM 5224, 3 hours), Adv Applic in Mol Life Sci (BCHM 5784 , 3 hours) and Research Ethics in Ag & Life Sci (ALS 5324, 1 or 2 hours) . All students must present a seminar and defend a thesis describing the results of their research as a final step for the completion of M.S. degree requirements.*Substitutions must be approved, in advance, by the student's advisory committee and ratified by the Graduate School. A complete description of the Academic requirements for Ph.D. Degree is also available in the Graduate Student Handbook (https://www.biochem.vt.edu/content/dam/biochem_vt_edu/graduate/graduate-handbooks/Graduatehandbook_2021.pdf).

GRADUATE COURSES (BCHM)

BCHM 5004:

Seminar in Biochemistry

Review and discussion of current problems and literature in biochemistry and nutrition. Student presentation of research results, faculty research, and visiting lecturers. May be repeated. Biochemistry majors only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BCHM 5014:

Techniques in Biochemical Research

Application of modern biochemical concepts and techniques in research on protein and nucleic acid biochemistry, structure, function, gene expression and organization; microbial metabolism coenzyme biosynthesis; structure and function of membranes and subcellular organelles. Pre-requisite: Graduate standing in Biochemistry. May be repeated once for credit.

Credit Hour(s): 4

Lecture Hour(s):

Instruction Type(s): Lab

Instruction Type(s): Lab

Prerequisite(s):

Corequisite(s):

BCHM 5024:

Computational Biochemistry for Bioinformatics

Applications of protein structure and function, protein characterization, enzyme kinetics, and analysis of metabolic control for students with a background in computer science, mathematics, statistics, or engineering. Pre: B.S or senior standing in computer science, mathematics, statistics, or engineering. Not available to life science majors for credit.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BCHM 5064:

Seminar in Molecular Cell Biology and Biotechnology

Review and discussion of current problems and literature in molecular cell biology and biotechnology by students, VPI&SU faculty and outside speakers. Students give formal presentations of research results or current literature. May be taken on pass-fail basis. Students enrolled in the MCBB Ph.D. option will be required to give one formal presentation on an A-F basis. Graduate status in participating MCBB departments

required.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BCHM 5124:

Biochemistry for the Life Sciences

Basic principles of biochemistry including protein structure, enzymology, gene expression, bioenergetics, and pathways of energy metabolism. Not available to Biochemistry majors.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHEM 2536 (UG)
Corequisite(s):

BCHM 5224:

Protein Structure and Function

Structure and function of proteins. Topics include special techniques in protein purification and characterization, techniques for studying protein structure, posttranslational modification of proteins and selected topics to study the structure-function relationship of proteins. Taught alternate years.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (BCHM 4115 (UG) OR BCHM 5115 (UG) OR BCHM 5124 (UG)) OR (BCHM 4115 OR BCHM 5115 OR BCHM 5124)
Corequisite(s):

BCHM 5344 (PPWS 5344):

Molecular Biology for the Life Sciences

A multi-disciplinary treatment of gene organization and expression in animal and plant systems. Emphasis on the applications of molecular biology to current problems in applied biology and biotechnology.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (BCHM 4116 (UG) OR BCHM 5124 (UG)) OR (BCHM 4116 OR BCHM 5124)
Corequisite(s):

BCHM 5784G:

Adv Apps Molecular Life Sci

Synthesis and application of biochemistry, cell biology, genetics, genomics, physiology, immunology concepts and techniques to address medical and agricultural problems. Genre characterization and manipulation, protein-based drugs, diagnostics, vaccines, transgenic plants/animals. Advanced analysis, critique, application of research in molecular life science. Prerequisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BCHM 5974:

Independent Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study
Instruction Type(s): Independent Study
Prerequisite(s):
Corequisite(s):

BCHM 5984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BCHM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

BCHM 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BCHM 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BIOLOGICAL SCIENCES

Robert Cohen, Head

Professors: John Barrett; Lisa Belden; Cayelan Carey; Daniela Cimini; Carla Finkielstein; Michael Friedlander; Dana Hawley; Roderick Jensen; Anthony LaMantia; Maria Lazar; Liwu Li; Ignacio Moore; Brent Opell; David Popham; Birgit Scharf; Ann Stevens; Dorothea Tholl; Jeffrey Walters; Brenda Winkel; Zhaomin Yang;

Associate Professors: Frank Aylward; Bryan Brown; Daniel Capelluto; Jing Chen; Silke Hauf; Erin Hotchkiss; Shihoko Kojima; Kate Langwig; Joel McGlothlin; Stephen Melville; Meryl Mims; Florian Schubot; Kendra Sewall; James Smyth; Robert Thomas; Josef Uyeda; Richard Walker; Susan Whitehead;

Assistant Professors: Julia Allen; Daniel Cortes Estrada; Jeremy Draghi; Austin Gray; Joseph Hoyt; Bryan Hsu; Alexandria Igwe; Scott Johnstone; Hanh Lam; Jessica Pfleger; Anton Suvorov; Jose Vargas-Muniz;

Harold Bailey Professor: Jeffrey Walters;

Assistant Professor of Practice: James Tokuhisa;

Graduate Contact: BiologyGrad@vt.edu

Graduate Site: http://www.biol.vt.edu/graduates/index.html

The Department of Biological Sciences offers research and training that lead to the M.S. and Ph.D. degrees. Graduate students, in consultation with Major Advisors, design programs of study that include cutting edge research, courses that support their particular interests, and at least one semester of a teaching experience. Opportunities for research span the biological disciplines from molecular biology to ecosystems ecology and may include computational, experimental, empirical, theoretical, and/or applied approaches. Our faculty members encourage graduate students to reach their full creative and scholarly potential. We take a holistic approach to graduate education by promoting both research skills and the ability to communicate effectively with professional colleagues and undergraduate students. In addition to their research program, graduate students may elect to earn a graduate certificate in "The Future Professoriate," which includes mentored classroom teaching. In short, our program fosters individually tailored programs that lead to successful careers in research and education. We encourage prospective students to visit the department's webpage to learn about research focus areas and associated interdepartmental programs, and to explore the research programs of potential Major Advisors by perusing faculty web pages. Contacting individual faculty members and their students prior to formal application provides opportunities to explore mutual interests. Deadlines To compete for financial aid, applications for fall admission must be completed by December 15. Applications are accepted through March 31, but the opportunities for financial aid are diminished. Most graduate teaching assistantships are awarded by April 30. October 31 is the deadline for spring semester applications (domestic students). We do not accept international applications for spring semester.

SPECIAL FACILITIES

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Introduction

The Department of Biological Sciences occupies modern research facilities in several buildings on the Virginia Tech Blacksburg campus, including Derring Hall, Latham Hall, the Integrated Life Sciences Building, and Life Sciences Building I. Biological Sciences faculty also utilize state-of-the-art research space in the Biocomplexity Institute in Blacksburg and the Virginia Tech Carilion Research Institute in Roanoke. Our research laboratories are well-equipped to conduct research in all areas of biology, from protein structure to microbiology to animals and plants to ecosystems. Graduate students carry out experiments to address challenges in topics such as infectious disease, cancer, water, behavior, and global change. The department houses a variety of advanced microscopy, analytical chromatography, computational, and molecular biology equipment. Support facilities for growth of microorganisms, greenhouses, and animal care are located within or near to department research buildings, as are facilities for advanced genomics, proteomics, spectroscopy, and crystallography. Of particular note is the Massey Herbarium, which contains over 115,000 specimens.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL or IELT

Paper (TOEFL): (577.0)

Computer (TOEFL): (233.0)

iBT (TOEFL): (90.0)

IELT: (6.5)

GRE Not Required

Course work requirements: (18 total graded hours) A minimum of 12 hours at the 5000 level 3 additional hours of seminars A maximum of 3 hours at the 4000 level A total of 18 graded hours and 30 total hours including research and thesis credits are required. Thesis is required. All biological sciences graduate students must teach a minimum of one semester as a requirement for graduation.

PhD Degree

Offered In (Blacksburg)

TOEFL or IELT

Paper (TOEFL): (577.0)

Computer (TOEFL): (233.0)

iBT (TOEFL): (90.0)

IELT: (6.5)

GRE Not Required

Course work requirements: (22 total graded hours) A minimum of 18 graded course hours at the 5000 level 4 additional hours of seminars A total of 22 graded hours and 90 total hours, including research and dissertation credits are required. All biological sciences graduate students must teach a minimum of one semester as a requirement for graduation.

GRADUATE COURSES (BIOL)

BIOL 5024:

Population and Community Ecology

Population dynamics, interspecific interactions, succession, and diversity of plants and animals. Quantitative approaches emphasized. Ecology course required.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5034 (FREC 5034):

Ecosystem Dynamics

Application of the systems perspective to functional characteristics and dynamics of ecosystems: energy flow, biogeochemical cycling, and stability/resilience in the response to environmental change. Computer simulation of ecosystem response to change. Pre: Graduate Standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): (MATH 2015 (UG), CS 1014 (UG)) OR (MATH 2015, CS 1014)

Corequisite(s):

BIOL 5064:

Seminar in Molecular Cell Biology and Biotechnology

Review and discussion of current problems and literature in molecular cell biology and biotechnology by students, VPI&SU faculty and outside speakers. Students give formal presentations of research results or current literature. May be taken on pass-fail basis. Students enrolled in the MCBB Ph.D. option will be required to give one formal presentation on an A-F basis. Graduate status in participating MCBB departments required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5094:

Methods in Biogeochemical Analysis

Quantitative methods in the analysis of air, water, soil and sediment samples for biogeochemical properties and processes. Sample collection, preparation, instrument calibration, operation and trouble-shooting, quality assurance and reporting of biogeochemical data. Pre: Graduate Standing.

Credit Hour(s): 2

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5114:

Advanced Global Change Ecology

Human alterations of climate, landscapes and biogeochemical cycling influence ecological structure and functioning at the global scale. Such changes have the potential to disrupt natural and managed ecosystems with potentially significant biological and economic impacts. This course will examine the influences of these global changes on ecosystem processes and biodiversity, drawing on paleo-and contemporary examples. Current and future potential feedbacks between biological systems and the global environment will also be addressed. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5134:

Advanced Evolutionary Genetics

Genetic variation, agents of change in gene frequencies, molecular evolution, mechanisms of speciation, ecological speciation. Comparison of theoretical models with natural and laboratory populations.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5174:

Graduate Seminar

Offered in the major subdisciplines of biology.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5184:

Prokaryot Recombinant Proteins

Concepts of bacterial recombinant protein expression, purification, and handling. Protein bioinformatics resource and the functional characterization of proteins with biochemical and biophysical techniques. Discussion of research articles related to class topics. Prerequisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BCHM 4115

Corequisite(s):

BIOL 5334:

Advanced Chemical Ecology

Chemical interactions between organisms with emphasis on the plant biosphere. Fundamental concepts, theories, and general methodology of chemical ecology; mechanisms of chemically-mediated interactions between plants and other organisms; effects of global change on chemical interactions; and engineering of natural chemical defenses in sustainable agriculture. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5404:

Neuroethology

Overview of Neuroethology, the study of the neural basis of animal behavior. Topics include: organization of the nervous system, control and coordination of movement, sensory transduction, visual and auditory prey detection and recognition, visual communication, matched filters/predictive coding of sensory information, learning templates, computational maps, sensory integration, behavioral plasticity, spatial cognition, neural plasticity, and lateralization of neural function.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5424 (CS 5424) (GBCB 5424):

Computational Cell Biology

Use of mathematical models (nonlinear ordinary differential equations and stochastic processes) and simulation algorithms to explore the complex feedback circuits that control the behavior of living cells. Concepts and techniques from dynamical systems theory, bifurcation analysis, numerical methods, SBML (systems biology makeup language) and Matlab programming. Applications in gene regulatory networks, cell cycle control, circadian rhythms, cell signaling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MATH 5515

Corequisite(s):

BIOL 5434:

Behavioral Endocrinology

Overview of the hormonal basis of animal behavior. Topics: include: sex differences in behavior, male and female reproductive behavior, parental behavior, aggressive and other social behaviors, stress, affective disorders, learning and memory, homeostasis, and biological rhythms. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5504:

Quantitative Methods in Ecology and Evolution

Approaches for data curation, plotting, manipulation, and analysis in ecology and evolution. Statistical philosophies as applied to ecological and evolutionary datasets. Hypothesis testing, model comparison, linear, generalized linear, and mixed models. Quantitative literacy in ecology and evolution. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5514:

Quantitative Analysis Of High-Dimensional Ecological Data

Analyses of high-dimensional ecological data such as those produced from environmental surveys and studies of ecological communities. Curation and visualization of complex data; quantifying diversity; concepts of ecological similarity; testing for differences in high-dimensional space. Application of techniques to case histories and/or students own data. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5564:

Adv Infectious Disease Ecology

Advanced overview of the principles of infectious disease dynamics from ecological and evolutionary perspectives. Examines a variety of wildlife hosts and disease-causing agents. Selective coverage of specific host and pathogen models to illustrate underlying principles of wildlife disease emergence, maintenance, and spread, as well as connections between wildlife and human health. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5624:

Advanced Microbial Genetics

Molecular genetics of bacteria and their associated plasmids and phages. Review of research from the current literature for methodology and standards of data analysis.

Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5634:

Microbial Physiology

The study of the structure, function and metabolic activities of prokaryotic microorganisms. Topics covered include cell composition and growth, metabolic unity and diversity, patterns of regulation, transport mechanisms, environmental sensing and response and cellular differentiation processes. Students will give presentations and critically analyze current literature in the field.

Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5664:

Advanced Virology

Classification, structure, replication, and pathogenesis of viruses of animals, plants and bacteria. Epidemiology, prevention, and treatment of viral infections. Approaches to the study of viruses. Pre: Graduate Standing

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5674:

Advanced Pathogenic Bacteriology

Characteristics of bacteria that cause human disease, nature of infectious processes and the host immune system, virulence factors, epidemiology, resistance, immunization. Current research in bacterial pathogenesis. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5734:

Advanced Inflammation Biology

Cellular and molecular pathways controlling human responses to inflammatory challenges. Regulation of immune cells during inflammation. Interaction of host cells and tissues with environmental risk factors that cause inflammation. Pathogenesis of inflammatory diseases including cardiovascular diseases, diabetes, multi-organ failure, neurological diseases and sepsis. Therapeutic intervention of inflammatory diseases. Discussion of current literature. Integrative approached to study of inflammation will be critically evaluated and synthesized. Prerequisite: Graduate Standing required.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5814:

Scientific Analysis Skills in Molecular and Cellular Biology

Searching the molecular and cell biology literature. Analysis and assessment of experimental design, methods, statistical techniques, data presentation, and impact of molecular and cellular biology studies. The publication and peer review process. Development of scientific writing, data visualization and presentation skills. Examples from the latest literature and from students' own research. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5824:

Advanced Bioinformatic Methods

Application of bioinformatics methods in biological research. Methods to access bioinformatics data. Theory and methods for analysis of DNA sequences, and analysis of complex data sets including whole genome sequences and gene expression data. Use of standard bioinformatics software and databases. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5834:

Advanced Practical Analysis of Protein Structure and Function

Application of biophysical and biochemical methods for the characterization of proteins. Protein structure and function, macromolecular interactions, and conformational changes. Strategies, experimental design, practical considerations, troubleshooting, data analysis. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5844:

Advanced Proteomics and Biological Mass Spectrometry

Introduction to mass spectrometry (MS) instrumentation and advanced proteomic methods for systems biology applications. Peptide mass fingerprinting, tandem MS, quantitation, phospho/glyco proteomics, and bioinformatics tools for evaluation and interpretation of mass spectrometry data. Includes three 4-hour lab sessions. Prerequisite: Graduate Standing required.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5854:

Advanced Cytogenics

Structure and function of eukaryotic chromosomes. Model systems to study specific chromosome substructures and functions. Techniques to identify and classify normal and aberrant chromosomes. Diseases caused by defective chromosome structure and/or function. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5884:
Molecular Biology of the Cell
Current concepts of the molecular organization of animal and plant cells. Topics include membrane structure and function, organelle biosynthesis and function, intracellular signaling, the cytoskeleton, the cell cycle, tissue formation and modern experimental methodologies.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (BIOL 3774 (UG) OR BCHM 4116 (UG)) OR (BIOL 3774 OR BCHM 4116)
Corequisite(s):

BIOL 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

BIOL 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

BIOL 6004:
Topics in Ecology and Systematics
Reading and discussion in a specific area of ecology and systematics. Topic will vary, and course may be taken for credit more than once. Background in ecology or systematics required.
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 6014:
Topics in Evolutionary Biology
Readings and discussion in a specific area of evolutionary theory, ecological genetics, or molecular evolution. Topics will vary, and course may be taken for credit more than once. Background in genetics and population biology required.
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIOL 6064:
Topics in Freshwater Ecology
Readings and discussion in a specific area of freshwater ecology, including species interactions, and community level functions. Topics will vary, and course may be taken for credit more than once.
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BIOL 4004
Corequisite(s):

BIOL 6404:
Topics In Vertebrate Biology
Readings and discussion in a specific area of vertebrate biology. Topic will vary, and course may be taken for credit more than once. Background in vertebrate biology required.
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

BIOL 6704:

Topics in Immunology

Readings and discussion in a specific area of immunology. Topic will vary and course may be taken for credit more than once.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BIOL 4704 (UG) OR BIOL 4704

Corequisite(s):

BIOL 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIOL 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BIOLOGICAL SYSTEMS ENGINEERING

Dwayne Edwards, Head

Emeriti Faculty: John Cundiff; Robert Grisso; Conrad Heatwole; Mary Leigh Wolfe;

Professors: Justin Barone; Brian Benham; Zachary Easton; Dwayne Edwards; William Hession; Saied Mostaghimi; David Sample; Chenming Zhang;

Associate Professors: Feras Batarseh; Leigh Anne Krometis; Jactone Ogejo; Durelle Scott; Ryan Senger; Venkataramana Sridhar; Theresa Thompson;

Assistant Professors: Abhilash Chandel; Juhong Chen; Jonathan Czuba; Anna Duraj-Thatte; Julie Shortridge; Wujin Sun; Zhiwu Wang; Robert Wright;

H.E. and Elizabeth F. Alphin Professor: Saied Mostaghimi;

General Contact: lizaas14@vt.edu

Graduate Site: https://www.bse.vt.edu/graduate.html

Biological Systems Engineering (BSE) is the engineering discipline that applies concepts of biology, chemistry and physics, along with engineering science and design principles, to solve problems in biological systems. The mission of the Biological Systems Engineering Department is to develop and disseminate engineering knowledge and practices that protect natural resources and improve sustainable production, processing, and utilization of biological materials. Our faculty and students work in a broad range of biological systems, from natural systems, such as watersheds with a focus on water resources, to built systems, such as bioreactors and bioprocessing facilities. We work from the nanoscale to the macroscale. We seek to improve animal, human, and environmental health through development and design of healthy food products, vaccines, bioenergy, biomaterials, and water quality management practices. We convert biological resources, such as switchgrass, plant proteins, and animal manure, into value-added products, such as biopharmaceuticals, biofuels, and biomaterials, in a sustainable manner.

SPECIAL FACILITIES

Information about the following facilities is available on our web site:

Facilities

Bionanotechnology Laboratory Bioseparation Laboratory BSE Pilot Laboratory Byproduct Management Laboratory Ecological Engineering Laboratory Environmental Processes Laboratory Food Safety & Biosensors Laboratory Fluvial Processes Laboratory Food Processes Laboratory Hydroecology Laboratory Metabolic Engineering and Renewable Materials Laboratory Plant Synthetic Biology Laboratory Prices Fork Research Facility Sediment Laboratory StREAM Lab Water Microbiology Laboratory Water Quality Laboratory Water Systems Modeling Laboratory Watershed Assessment Laboratory Watershed Monitoring Laboratory

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal, Quantitative, Analytical

Master of Science - Thesis (MS)The Department offers the MS thesis degree. The student in the MS program will conduct independent research and will produce a thesis and defend the research findings for fulfilling the requirements of the degree. A minimum of 30 total credits (24 course credits) are required.

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal, Quantitative, Analytical

Master of Engineering (ME)The ME degree is a non-thesis course of study designed for those who are interested in broadening their general knowledge of Biological Systems Engineering, rather than specializing in one specific area. Although a thesis is not required for this degree program, the students are required to complete a project report. Thirty credit hours, including 3 to 6 credit hours of Project and Report are required. This degree is not recommended for students who might be interested in pursuing a PhD degree. The students in a ME program are not eligible to receive research assistantships from the Department.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal, Quantitative, Analytical

PhD (post-MS)This option is for students who already have an MS degree and would like to continue their academic career in order to receive a PhD. The PhD is the highest academic degree awarded by the University and is conferred upon a student who demonstrates outstanding original scholarship during advanced study. It signifies that the student is able to conduct independent research and has both a broad basic knowledge of all areas of the field and a comprehensive knowledge of one area. A student who wishes to qualify for the degree is expected to meet the requirements of both the Graduate School and the Department.Direct PhDThe Direct Admit to PhD (Direct PhD) program is for exceptional students with research experience who have a BS degree and want to be admitted to the Direct PhD Program without completing an MS degree. These students should have excellent academic records with a minimum grade point average of 3.5 (for the last 60 credit hours) and should be able to provide evidence of research activities to indicate their ability to synthesize information and conduct research experiments. Annual evaluations of the Direct PhD students will be conducted by the Graduate Committee and the student's Advisory Committee. If it is determined that the student does not possess the ability to successfully complete a PhD degree, the Advisory Committee and the Department would consider awarding a non-thesis MS degree, provided that all university requirements for this degree are met by the student. Successful students will proceed with their program and follow all Departmental policies and procedures established for the PhD program.

GRADUATE COURSES (BSE)

BSE 5044 (CHE 5044) (BMES 5044):

Engineering Mathematics

Introduction to numerical solutions of partial differential equations using the finite element method in one-, two-, and three-dimensions with direct relevance to chemical engineering, biological systems engineering and biomedical engineering and sciences. Partial differential equations and ordinary differential equations using finite differences, model parameter sensitivity analysis, optimization, and data analysis. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5214:

Advanced Topics in Biological Systems Engineering

An interdisciplinary exploration of advanced topics in watershed management. Reading, discussion, summary and presentation of current research in the areas of water quality and watershed management. Topics will be built around a semester theme that will vary by semester; the course may be repeated up to three times. Graduate standing required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5224G:

Advanced Field Methods in Hydrology

Site characterization: surveying, channel and floodplain mapping, land use, electronic data acquisition. Techniques for measuring surface and subsurface hydrological processes: water flow, hydrologic conductivity, precipitation, evaporation. Sampling techniques: surface water, groundwater, and soil pore water sampling. In-situ monitoring: automatic samplers, dataloggers, water quality sondes. Laboratory analyses: GLP practices, selection of analytical method, calibration, QA/QC. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5244 (CEE 5244):

Advanced GIS in Hydrologic Analysis

Advanced GIS course focusing on raster analysis with particular application to the issues associated with hydrologic analysis. Application and evaluation of algorithms for terrain analysis, watershed characterization, and hydrologic analysis and modeling as implemented in GIS. Digital elevation data sources and error assessment. Approaches to GIS/model integration and application.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): BSE 4344 (UG) OR CEE 5204 (UG) OR GEOG 4084 (UG), BSE 3305 (UG) OR CEE 4304 (UG)

Corequisite(s):

BSE 5304G:

Advanced Watershed Modeling

Fundamental modeling principles used to quantify watershed hydrology, energy budgets, and associated ecosystem functions, such as plant dynamics and biogeochemical processes, at scales ranging from soil pores to watersheds. Code development and model integration to simulate watershed hydrology and nutrient and sediment transport. Model calibration and performance assessment. Data discovery, acquisition, and processing of data relevant to hydrologic/watershed modeling. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5324:

Applied Fluvial Geomorphology

Introduction to landscape evolution. Influence of geology and climate on stream form and processes. Fundamental river mechanics and sediment transport. Stream surveying and classification. River system response to changes in hydrology and sediment supply. Interactions between ecosystems and fluvial systems. Human impacts on stream systems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5344G:

Applied Geographic Information Systems

Conceptual, technical, and operational aspects of geographic information systems as a tool for storage, analysis, and presentation of spatial information. Focus on engineering applications in resource management, site selection, and network analysis. Laboratory work required. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5364:

Stream Restoration

Stream restoration practices related to channel dynamics, sediment transport, impact of human activities, aquatic habital improvements, and design and assessment. Inspecting, classifying, identifying and measuring river features of channel morphology to predict river reaction to human activities and watershed change.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): BSE 5324

Corequisite(s):

BSE 5404:

Agricultural Nonpoint Source Pollution

Assessment and management of agricultural nonpoint source pollution (NPS). Precipitation, runoff, erosion, pollutant fate and transport, and best management practices. Application of Total Maximum Daily Loads and water quality standards. Pre: Background in physical, chemical, biological, and soil factors affecting the environment and in environmental regulations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5544G (CHE 5544G):

Advanced Protein Separation Engineering

Concepts, principles and applications of various unit operations used in protein separations. Properties of biological materials, such as cells and proteins, and their influences on process design. Design of processes for protein purification based on the impurities to be eliminated. Concepts and principles of scale-up of unit operations. Case studies in practical protein recovery and purification issues, with a focus on enhanced protein purification by genetic engineering. Protein purification process simulation and optimization using process simulation software. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BSE 3504 (UG) OR BSE 3504 OR CHE 3144 (UG) OR CHE 3144

Corequisite(s):

BSE 5564G:

Advanced Metabolic Engineering

Engineering concepts for analyzing, designing, and modifying metabolic pathways to convert raw materials to food, pharmaceuticals, fuels and chemicals. Cell metabolism, pathway design, bioenergetics, regulatory mechanisms, metabolic modeling, and genetic tools. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5614:

Advances in Recombinant Protein Production

Concepts, principles and applications of various expression systems for protein and enzyme production, and the principles and applications of the most current unit operations used in bioseparations. Principles and applications of various methods for protein molecular modification to facilitate its downstream processing. Protein engineering by directed evolution and rational design. Mutant selection and identifications, and establishment of mutant library for protein expression. In vitro synthetic enzymatic biosystems for biomanufacturing. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BSE 5944:

Seminar

Selected presentations and discussions by graduate students and faculty.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

BSE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BSE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BSE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BIOLOGICAL TRANSPORT

Professors: Daniela Cimini; Rafael Davalos; Raffaella De Vita; Linsey Marr; Shane Ross; David Schmale; Eva Schmelz; John Socha; Mark Stremler;

Associate Professors: Nicole Abaid; Jonathan Boreyko; Stephen Melville; Anne Staples;

Assistant Professors: Jing Chen; Hosein Foroutan; Clement Vinauger Tella;

Research Assistant Professors: Chloe Lahondere;

Program Administrator: sallys@vt.edu

Biological Transport Program: https://biotrans.fralinlifesci.vt.edu

The Biological Transport (BIOTRANS) program provides a framework for interdisciplinary education and research that trains future leaders of academic and industrial research to think, collaborate, and contribute at the intersection of the biological and engineering sciences. This program develops participants who are experts in a core discipline of engineering or biology and who are also proficient in the alternate discipline, with understanding and appreciation of its methods, culture, and perspectives. BIOTRANS trainees can receive 12 months of financial support from the program while working toward a graduate degree in one of the departments listed below.To receive full consideration for financial support in the following academic year, applications should be submitted by January 15.For more information please visit https://biotrans.fralinlifesci.vt.edu or contact Sally Shrader, Program Administrator, via email at sallys@vt.edu Colleges, Programs, & Faculty (*Executive Committee members): College of Engineering Aerospace and Ocean Engineering - Shane Ross Civil & Environmental Engineering – Hosein Foroutan, Linsey Marr Biomedical Engineering & Mechanics – Rafael Davalos, Raffaella De Vita, *Jake Socha, Anne Staples, Mark Stremler Mechanical Engineering - Jonathan Boreyko College of Science Biological Sciences – Jing Chen, *Daniela Cimini, Steve Melville Mathematics - Nicole Abaid College of Agricultural & Life Sciences Biochemistry - Chloe Lahondere, Clement Vinauger Human Nutrition, Foods, and Exercise – Eva Schmelz School of Plant and Enviromental Sciences Plant Pathology, Physiology & Weed Science – David Schmale

SPECIAL FACILITIES

Program participants have access to the office and laboratory facilities of their advising faculty; see the faculty list under Program Overview.

DEGREES OFFERED

IGEP Degree

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

Biological Transport (BIOTRANS) previously known as Multi-Scale Transport in Environmental and Physiological Systems participants earn a degree from one of the participating degree-granting programs; see the list of programs under Program Overview and visit the relevant Graduate Catalog entry for your program of interest.

BIOMEDICAL AND VETERINARY SCIENCES

Emeriti Faculty: Marion Ehrich;

Professors: S Ahmed; Virginia Buechner-Maxwell; Gregory Daniel; Jennifer Hodgson; Laura Hungerford; Kylene Kehn-Hall; Otto Lanz; Martha Larson; Tanya LeRoith; Margie Lee; Xiang-Jin Meng; Kevin Pelzer; Kerry Redican; John Rossmeisl; Mohamed Seleem; Stephen Smith; Dan Sponenberg; William Swecker; Lijuan Yuan; Kurt Zimmerman;

Associate Professors: Irving Allen; Orsolya Balogh; Jennifer Barrett; Michele Borgarelli; Christopher Byron; Clayton Caswell; Thomas Cecere; Sherrie Clark-Deener; Rebecca Funk; Julia Gohlke; Jia-Qiang He; Piedad Henao Guerrero; Ian Herring; William Huckle; Kevin Lahmers; Sunshine Lahmers; Xin Luo; Harold McKenzie; Albert Pan; Patrick Pithua; Audrey Ruple; Bonnie Smith; Michelle

Theus; Sharon Witonsky; Hehuang Xie;

Assistant Professors: Ilektra Athanasiadi; Charlotte Baker; Andrea Bertke; Sophie Bogers; Timothy Bolton; Ryan Calder; Julie Cecere; Alasdair Cohen; Natalie Cook; Lisa Corcoran; Jennifer Davis; Nikolaos Dervisis; Nisha Duggal; Kristin Eden; Shannon Farris; Mark Freeman; Rajshekhar Gaji; Erin Gloag; Shawna Klahn; Tessa LeCuyer; Giulio Menciotti; Paul Morton; Kathleen Mulvaney; Vaidehi Paranjape; Rell Parker; Jacquelyn Pelzer; Roxanne Rodriguez Galarza; Nick Ruktanonchai; Yassine Sassi; Megan Shepherd; Richard Shinn; Jamie Stewart; Sharon Swanger; Joanne Tuohy; Renata Velloso Ramos; James Weger; Ashley Wilkinson; Jia-Ray Yu;

Adjunct Faculty: Blaise Costa; Sheryl Coutermarsh-Ott; Stephen Eubank; Theresa Hrubec; Christopher Reilly;

Associate Professor of Practice: Travis Burns; Valerie Ragan;

Assistant Professor of Practice: Cassidy Rist;

Clinical: Rebecca Funk; Sunshine Lahmers; Roxanne Rodriguez Galarza; Megan Shepherd;

Research Assistant Professors: Priscila Beatriz da Silva Serpa;

Research Associate Professors: Aloka Bandara;

Clinical Associate Professors: Francisco Carvallo; Bobbi Conner; Michael Nappier; Roger Ramirez Barrios; Katherine Wilson;

Clinical Assistant Professors: Brittany Ciepluch; Audrey Keebaugh; Marcela Lemos Machado;

Collegiate Assistant Professors: Corrine Ruktanonchai;

Clinical Professors: Lauren Burns;

General Contact: bmvsgrad@vt.edu

Graduate Contact: greena15@vt.edu

General Contact: mctaylor@vt.edu

Biomedical & Veterinary Sciences: https://bmvs.vetmed.vt.edu

The Department of Biomedical and Veterinary Sciences (BMVS) is an integral part of the College of Veterinary Medicine and the Graduate School of Virginia Tech. The graduate program was initiated in 1986. In contrast to many departments and colleges on this campus, there is a single multidisciplinary graduate program for our college which is recognized by the Graduate School as a graduate department. The goal of this program is to train students to be creative and sophisticated research scientists in fields associated with biomedical research. The association with the College of Veterinary Medicine allows students the unique opportunity to explore both basic research, advanced pre-clinical animal model studies, natural clinical disease in animals, and translational research impacting both veterinary and human patients and populations. Our graduate program encourages collaborative, multidisciplinary research to achieve optimal health outcomes for people, animals, and the environment. To this end, we emphasize acquisition of a foundation of knowledge, research skills, and wet or dry laboratory experience required to implement independent research projects and develop the ability to formulate experimental and observational approaches to solve contemporary problems in the biomedical sciences.A basic philosophy of graduate education in biomedical and veterinary sciences is flexibility. Programs of study - courses, laboratory and field research, clinical experiences, and teaching opportunities - are tailored to meet the individual student's needs, depending on academic background, professional experience and career goals. The college prides itself on the high quality of faculty mentoring/advising, and support services.

SPECIAL FACILITIES

Faculty Research Laboratories are well equipped for modern molecular research and/or clinical studies. The following Core Research Service Laboratories are available to support the work of graduate students.

Analytical Research Lab

Center for One Health Research (COHR)

Electron Microscope Lab

Flow Cytometry

Glassware/Media Preparation

Quality Assurance Unit (Good Laboratory Practice)

Study Design and Statistical Analysis Lab

Teaching and Research Animal Care Support Service (TRACSS)

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

iBT: Overall (90.0), Listening (20.0), Speaker (20.0), Reading (20.0), Writing (20.0)

IELTS

IELTS: Score (6.5)

The MS degree comprises a combined total of 30 credit hours of course work, research and thesis, and can be completed in two years.

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: Overall (90.0), Listening (20.0), Speaking (20.0), Reading (20.0), Writing (20.0)

IELTS

IELTS: Score (6.5)

The PhD degree comprises a combined total of 90 credit hours of course work, research and dissertation. The PhD can be completed in four years. It is not required to have a Master's degree before entering the

PhD program.

GRADUATE COURSES (BMVS)

BMVS 5005 (VM 9085):

Emerging Infectious Diseases

Stand-alone, fully on-line, asynchronous distance and distributed learning course, accessible as streaming videos on the internet or on CDs. 5005: The course defines and discriminates amongst numerous factors influencing the emergence of infectious diseases. Selected emerging food-borne, bacterial, viral, zoonotic diseases of animals and humans are described and analyzed. 5006: The course expands the pathology of emerging infectious diseases. Additional viral, parasitic and zoonotic diseases of animals and humans are described and analyzed. Xenotransplantation is also discussed from the perspective of zoonotic diseases. Third year standing in the DVM curriculum, or good standing in a graduate studies program is required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5006:

Emerging Infectious Diseases

Stand-alone, fully on-line, asynchronous distance and distributed learning courses, accessible as streaming videos on the internet or on CDs. 5005: The course defines and discriminates amongst numerous factors influencing the emergence of infectious diseases. Selected emerging food-borne, bacterial, viral, zoonotic diseases of animals and humans are described and analyzed. 5006: The course expands the pathology of emerging infectious diseases. Additional viral, parasitic and zoonotic diseases of animals and humans are described and analyzed. Xenotransplantation is also discussed from the perspective of zoonotic diseases. Third year standing in the DVM curriculum, good standing in a graduate studies program is required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5014:

Animal Pathology Residency

Training in diagnostic pathology through weekly rotations in the necropsy and surgical biopsy service of the teaching hospital. Students will perform necropsies and histopathologic examinations of necropsies and surgical biopsies and write diagnostic reports. The course is taken in weekly intervals of necropsy and/or surgical biopsy, with a credit hour given for each 2-week interval. Variable credit. May be repeated with a maximum of 5 hours. DVM degree required.

Credit Hour(s): 1 TO 5

Lecture Hour(s):

Instruction Type(s): Lab

Instruction Type(s): Lab

Prerequisite(s):

Corequisite(s):

BMVS 5044:

Veterinary Immunology

Study of immunological mechanisms effective in protecting animals from infectious and foreign agents. Includes the use of immunological reactions for diagnostic purposes and the role of immune mechanisms in the induction of diseases.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5094 (CHEM 5094) (FST 5094):

Grant Writing and Ethics

A framework for writing clear, concise grant proposals in a team-oriented, multidisciplinary approach from concept development through submission to a funding agency. Potential ethical dilemmas that may arise in academic, industrial, or federal research settings will be discussed. PRE: Undergraduate courses in one of the following: organic chemistry (CHEM 2565/2566), cell and molecular biology (BIOL 2104), Concepts of Biochemistry (BCHM 2024), or equivalent. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5124:

Reproductive Pathology

Study of lesions of the reproductive system of domesticated animals.

Relationship of these lesions to infertility and examination of the pathogenesis of the lesions and infertility.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ALS 4304 (UG) OR ALS 4304
Corequisite(s):

BMVS 5174:

Responsible Research Conduct

Scientific integrity and responsible conduct of research as related to studies in life sciences, physical sciences, social sciences, engineering, and humanities. Conflict of interest, human and animal subjects in research, mentor/mentee responsibilities, collaborative research, peer review, research misconduct, responsible authorship and publication, data management, sharing, and ownership, and legal issues in research. Pre: Graduate Standing.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 5194:

Clinical Micropathology

This course presents practical topics in diagnostic pathology. It covers the entire spectrum of disease processes, including the background of clinical, gross anatomic physiologic information required for integration with the microscopic changes observed to arrive at a correct diagnosis. DVM degree and permission of the instructor required.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 5224 (BMES 5024):

Biomedical Engineering and Human Disease

Comprehensive overview of a variety of human diseases, including neurological disorders, cardiovascular disease, infectious disease, and cancer, designed primarily for graduate students majoring in engineering and other related areas who have a long-term academic and professional goal in the field of biomedical engineering and life sciences. Introduction to state-of-the-art biomedical engineering approaches used for the study of early detection/diagnosis, treatment and prevention of human disease. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BMES 5004 OR BMVS 4064 (UG) OR BMVS 4064 OR BMES 4064 (UG)
Corequisite(s):

BMVS 5244:

Veterinary Pharmacology

Principles of pharmacodynamics and pharmacokinetics, including interaction of drugs with receptors; absorption, distribution and clearance; drug metabolism and drug interactions. Study of drugs by pharmacological classes, the general mechanisms of action, usefulness and side effects. Pharmaceutical calculations and prescription writing. May be repeated for a maximum of 5 credits. Pre-requisite: Graduate standing required
Credit Hour(s): 1 TO 5
Lecture Hour(s): 1 TO 5
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 5274:

Systems Pathology

This lecture only course covers the pathology and pathogenesis of specific lesions and diseases of each organ system at the gross and microscopic level. Emphasis is on diagnostic characteristics and interpretation of diseases. Pre: DVM or equivalent.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 5284:

Cellular Pathology

This course presents the mechanisms involved in cellular reaction to injury, inflammation, tissue repair and regeneration, circulatory disturbances (thrombosis, embolism, infarction, hemorrhage, edema, congestion, shock) and neoplasia and other alterations of cell growth. Emphasis will be placed upon disease processes at the cellular and tissue levels.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5324:

General Neurochemistry

Biochemical mechanisms involved in normal and abnormal nervous system function including discussions of experimental techniques, structural components, neurotransmitters, cerebral blood flow and metabolism, sensory systems, learning, mental disorders, and neuropharmacological agents.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (BCHM 4116 (UG) OR BCHM 5124 (UG)) OR (BCHM 4116 OR BCHM 5124)

Corequisite(s):

BMVS 5444:

Veterinary Anatomy II

Study of the structural and functional anatomy of carnivores (dog, cat), horses, and ruminants. Gross, developmental and radiographic morphology with applications for clinical diagnosis, interpretation, and surgical and medical treatment.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): VM 8014 OR BMVS 5434 (UG) OR BMVS 5434

Corequisite(s):

BMVS 5454:

Veterinary Physiology I

Study of physiological functions in companion, food, fiber, laboratory, zoo, and wildlife animal species. Emphasizes fundamentals and the overview of cellular, organ, and regulatory integration. Topics include cells, muscles, blood, respiration, circulation, environmental and regulatory physiology.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5464:

Veterinary Physiology II

Study of how living animals function. The central themes include close relationship between structure and function, process of adaptation, and the concepts of homeostasis and feedback control systems. The course focuses on the function of the tissues, organs, and organ systems of multicellular organisms.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5564 (VM 8534):

Introduction to Clinical Research

Design of studies in veterinary related clinical research, planning and implementation of experimental and survey data collection, management and analysis of data, evaluation of analysis and critical evaluation of published information. Instructor approval required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5574:

Advanced Poultry Diseases

An advanced course covering diagnosis, etiology, and treatment of poultry diseases. Diseases will be grouped by system affected, their common features detailed, and then unique characteristics of these diseases described.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5594:

Current Technologies in Biomedical Sciences

Current methodologies and techniques for hypothesis-driven scientific experimentation in biomedical research, including molecular biology approaches, microscopy, animal models, molecular applications, cell culture systems, large-scale omics methodologies, bioinformatics analyses, and clinical studies. Cutting-edge and novel approaches for designing experiments and interpreting the resulting data; review of scientific literature; and important considerations for the appropriateness and limitations of specific methods, approaches, and experimental models. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5624:

Molecular Virology

The principles and mechanisms of virus replication at the molecular level including transcription, translation and posttranslational modifications of virus genes, virus interaction with host, antivirals, vaccines and host defense mechanisms against virus infections. The replication and pathogenesis mechanisms of several important DNA and RNA virus families including biothreat viruses. Graduate standing required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5704:

Veterinary Cytopathology

Interpretation of cytopathologic samples. Descriptive reports. Routine to complex case material from animal tissue specimens. Prerequisite: Third year standing in the DVM curriculum.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5744:

Veterinary Parasitology

Study of the morphology and biology of parasites of veterinary importance. Considers of pathogenesis, diagnosis, signs, and treatment of parasitic diseases of animals. Study of the immunologic and pathophysiologic aspects of host/parasite relationships and the importance of zoonotic parasitic infections. II.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5764 (VM 8494):

Aquatic Medicine and Fish Health

The etiology, diagnosis, pathology, pathogenesis, chemotherapy, control and management of infectious and non-infectious diseases of aquatic organisms, especially pertaining to cultured food and tropical fish. Hands on experience with water quality evaluation, diagnostic techniques and the identification of common pathogenic organisms. Pre-requisite: Second year standing in the DVM curriculum.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): VM 8364 OR FIW 4514 (UG) OR FIW 4514

Corequisite(s):

BMVS 5794:

Clinical Neuropathology

This course uses necropsy tissues of clinical cases to present the mechanisms involved in neurologic disease of animals. Gross, microscopic, and radiologic approaches will be employed. Emphasis will be placed upon the correlation of clinical and pathological findings. May be repeated. Pre: Instructors approval required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5814 (VM 8254):

Functional Morphology and Natural History of Reptiles and Birds

Anatomical features will be described that are unique to, or are characteristic of, each major group covered. Adaptation and successful exploitation of habitat. Use of anatomical features and functions. Selected attributes of the groups natural history, members of the group common to the local and extended area, those commonly kept as pets. Pre-requisite: Graduate Standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BMVS 5944:

Seminar in Biomedical and Veterinary Sciences

Presentations by graduate students on current topics in Biomedical and Veterinary Sciences. Topics and responsibility for seminars is rotated among the professional departments of the college. Maximum 4 credits.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

BMVS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BMVS 6014:

Veterinary Clinical Sciences Residency

Advanced course with training and instruction in veterinary patient management. Supervised practicum in veterinary diagnosis and therapy in a veterinary teaching hospital. Material will include development of knowledge and skills for problem solving, performance of techniques, and effective communication. Regularly scheduled rounds and conferences will supplement daily activities. 0 credit. DVM degree required.

Credit Hour(s): 0

Lecture Hour(s): 0

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 6064:

Advanced Topics in Veterinary Medicine

Students will critically review and actively participate in discussion of current and important historic veterinary and comparative medical literature relevant to students residency specialty. DVM degree is required. May be repeated with different content for a maximum of 12 credit hours.

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 6074:

Clinical Topic Rounds

Practical, advanced training in specialty medicine. Students will participate in critical reviews of cases and current literature applicable to selected cases. Relevant information will include advanced diagnostic and therapeutic techniques applicable to the specialty and species being studied. An in-dept knowledge of the pathophysiology of animal disease processes and clinical problem solving will be developed. Students will be expected to gain an understanding of the general problem area to be studied and critically evaluated current literature and application to the case(s) being studied. DVM degree is required. May be repeated with different content for a maximum of 12 credit hours.

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 6084:

Veterinary Speciality Clinics

Practical, advanced training in specialty medicine. Students will learn advanced diagnostic and therapeutic techniques applicable to the specialty and species being studied. An in-depth knowledge of the pathophysiology of animal disease processes and clinical problem solving will be developed. Students will be given responsibility for case management with faculty guidance. DVM degree is required. May be repeated for a maximum of 12 credits with different content.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 6094:

Board Certification Topics

Structured preparation for the specialty examinations associated with residency programs and board certification. Topics will vary depending on the particular learning objectives required by the clinical discipline. Pre-requisite: Graduate standing and clinical resident in the Virginia Maryland Regional College of Veterinary Medicine. May be repeated for up to 6 credit hours with different content.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 6114:

Neurogenesis in the Developing and Diseased Brain

Development, maintenance and injury-induced response of stem cells in the brain. Key epigenetic and signal transduction pathways required for the proper development and adaptive response of stem cells in the neurogenic compartments after brain injury in rodents and larger animal species.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMVS 6514:

Equine Theriogenology I

An advanced study in the breeding management, estrous cycle manipulation, embryo transfer, parturition and the foaling issues, reproductive disease diagnoses and treatment of the mare and stallion. Practical application of the latest research covered in this species. Pre: Second-year standing in the DVM curriculum.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): VM 8634 OR (ALS 4304 (UG) OR ALS 4304)

Corequisite(s):

BMVS 6534:

Mechanisms of Disease in Veterinary Medicine

Advanced study of topics concerning the pathophysiology, diagnosis, and current therapy of diseases in Veterinary Medicine. Pre: DVM or equivalent, or consent of instructor. May be repeated to a maximum of 18 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 6554:

Advanced Epidemiology

This course is intended for students interested in applying analytical epidemiological methods in assessing the health and disease status of populations (animal and/or human) and the factors affecting that status. It will include lecture/discussion sessions and exercises on the design, analysis, and interpretation of clinical trials and cross-sectional, case-control, and longitudinal studies. Risk assessment and techniques for assessing and enhancing the validity of epidemiological studies will also be covered. Pre: third-year standing in the DVM curriculum.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 6564:

Advanced Veterinary Public Health

Consideration of the organization and delivery of Veterinary Public Services at the local, state, national and international levels including zoonoses surveillance, investigation and response to disease outbreaks, biological warfare and terrorism, response to natural emergencies and disasters, and public health policy formulation. Pre: third-year standing in the DVM curriculum.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 6594:

International Veterinary Medicine

Overview of international veterinary activities. Understanding of the role of governmental agencies, inter-governmental and non-governmental organizations in international relations, development, relief work, conservation, disease control and prevention, and trade. Understanding of the legal authority of binational agreements and international treaties. Training in intercultural communications, negotiation and conflict resolution. Review of current global issues. Pre: third-year standing in the DVM curriculum.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 6714:

Immunology in Health & Disease

Analysis of emerging, cutting edge and paradigm changing concepts of cellular and molecular immunology in human and animal health and disease. Innate immunity, adaptive immunity, developmental immunology, autoimmunity, immunodeficiency, cancer immunology, and transplantation immunology.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BIOL 5734 OR BCHM 5124
Corequisite(s):

BMVS 6724:

Mol Mech of Path Bacteria

Molecular mechanisms employed by pathogenic bacteria to cause infection. Classical and contemporary methods for studying host-pathogen interactions at the molecular level. Hypothesis-driven scientific experimentation in pathogenic bacteriology.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BIOL 5634 OR BIOL 5674
Corequisite(s):

BMVS 6984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMVS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BIOMEDICAL ENGINEERING

Joel Stitzel, Head
Jennifer Wayne, Head

Professors: Luke Achenie; Graca Almeida-Porada; Evelyn Anthony; Anthony Atala; Romesh Batra; Warren Bickel; John Bourland; Rafael Davalos; David Dillard; Thomas Diller; Thomas Dingus; Stefan Duma; Kevin Edgar; Wu-Chun Feng; Michael Friedlander; Francis Gayzik; William Gmeiner; Robert Gourdie; Metin Gurcan; Adam Katz; Daniel Kim-Shapiro; Paul Laurienti; Alexander Leonessa; Chang Lu; Michael Madigan; Pendleton Montague; Michael Morykwas; Andre Muelenaer; Michael Munley; T Murali; Maury Nussbaum; Emmanuel Opara; Boris Pasche; Mark Paul; Olga Pierrakos; Saad Ragab; Thanassis Rikakis; Shane Ross; John Rossmeisl; Hooman Sadri-Ardekani; Webster Santos; Shay Soker; Joel Stitzel; Mark Stremler; Danesh Tafti; Alexandra Thomas; Pamela VandeVord; William Wagner; Jennifer Wayne; James Yoo;

Associate Professors: William Baumann; Bahareh Behkam; Brooks Casas; Linda Dahlgren; Kerry Danelson; Raffaella De Vita; Jingzhong Ding; Zachary Doerzaph; Aaron Goldstein; Craig Hamilton; Warren Hardy; William Huckle; James Jordan; Kylie Kavanagh; Andrew Kemper; Charlie Klauer; Stephen LaConte; Yong Lee; Majid Manteghi; Xin Ming; Kristen Nicholson; Michelle Olsen; Miguel Perez; Steven Poelzing; Christopher Porada; Robin Queen; Edgar Romero-Sandoval; Steven Rowson; Eva Schmelz; Sean Simpson; James Smyth; John Socha; Anne Staples; Surot Thangjitham; Michelle Theus; Umit Topaloglu; Costin Untaroiu; Scott Verbridge; Vincent Wang; Ashley Weaver; Christopher Whitlow; Abby Whittington; Timothy Williams; Saami Yazdani; Dawen Zhao;

Assistant Professors: Irving Allen; Christopher Arena; Sara Arena; Alan Asbeck; Kristen Beavers; Philip Brown; Matthew Buczynski; Garrett Bullock; John Chappell; Arjun Chatterjee; Caitlyn Collins; Christina Cramer; Tracy Criswell; John Domann; Xin Feng; Netta Gurari; Adam Hall; Aiguo Han; Erin Henslee; Blake Johnson; Jamie Justice; Sohan Kale; Bethany Kerr; Jeongchul Kim; Ji Hyun Kim; Oleg Kim; Kenneth Kishida; Arina Korneva; Samy Lamouille; Sang Lee; Nicole Levi; Megan Lipford; Samuel Lockhart; James Lord; Da Ma; Shannon Macauley-Rambach; Joshua Maxwell; Alexei Morozov; Kathleen Mulvaney; Jennifer Munson; Sean Murphy; Lucas Neff; Muhammad Niazi; Alexander Powers; Elaheh Rahbar; LaDeidra Roberts; Heather Shappell; Thomas Shupe; Divya Srinivasan; Rong Tong; Joanne Tuohy; Alexandrina Untaroiu; Jillian Urban; James Ververs; Sujith Vijayan; Eli Vlaisavljevich; Jared Weis; Jeff Wiley;

L. Preston Wade Professor: Rafael Davalos;

Harry C. Wyatt Professor: Stefan Duma;

H. G. Prillaman Professor: Maury Nussbaum;

Samuel Herrick Professorship: John Socha;

Research Professors: Kimberly Horn; David Klorig; John Robertson;

N. Waldo Harrison Professor: Pamela VandeVord;

Kevin P. Granata Faculty Fellowship: Robin Queen;

Kevin P. Granata Fellow: Vincent Wang;

Clinical Professors: Sandeep Mittal;

Fred W. Bull: Chang Lu;

Research Scientists: Devon Albert; Luke Riexinger;

University Distinguished Professor and Clifton C. Garvin Provessor: Romesh Batra;

Adhesive and Sealant Science Professor: David Dillard;

Newport News-Tenneco Professor: Thomas Dingus;

Research Assistant Professors: Bethany Rowson;

Research Associate Professors: Jeffrey Stein;

General Contact: sbesinfo-g@vt.edu

Program Web Site: https://beam.vt.edu/graduate/biomedical.html

Department Web Site: http://www.beam.vt.edu

The Virginia Tech – Wake Forest University S chool of B iomedical E ngineering & S ciences (SBES) is a unique multidisciplinary program which couples the biomedical sciences, biomedical engineering, and real-world applications to enhance the quality of life. Our world-class faculty and students innovate and discover across a continuum of systems, from natural to engineered to medical. SBES is a fully joint graduate program formed in 2003 that brings together three prestigious academic units: the Virginia Tech College of Engineering, the Wake Forest School of Medicine, and the VA-MD College of Veterinary Medicine. Each of these separate entities contributes unique strengths to the combined enterprise so that students are offered a wide spectrum of first-class educational and research opportunities in a beautiful part of the country. The SBES program is available to students at two campus locations. Blacksburg, Virginia is home to the VT College of Engineering and the VA-MD Veterinary College, both of which provide faculty to the program. Winston-Salem, NC is the home of the Wake Forest University Baptist Medical Center consisting of Wake Forest University Health Sciences and North Carolina Baptist Hospital. Contributors to SBES include the clinical departments and the Department of Biomedical Engineering. SBES is a graduate level only program offering the following degree programs: M.S. in Biomedical Engineering Ph.D. in Biomedical Engineering DVM/PhD offered through the Veterinary School in Blacksburg MD/Ph.D. offered through the Wake Forest University School of Medicine. Accelerated undergraduate/graduate option (currently only at Virginia Tech) The SBES curriculum currently consists of courses and research focused in 9 broad areas of concentration which include: Automotive Safety Biomaterials Biomechanics Biomedical Imaging Cardiovascular Engineering Nanomedicine & Nanobioengineering Neuroengineering Tissue Engineering Translational Cancer Research SBES encourages innovative thinking and novel approaches to problem-solving and seeks to tailor students' academic programs to their individual goals and research ambitions. Please refer to the SBES handbook for further details regarding concentrations. One campus is chosen as the “home campus” but students have the opportunity to experience both environments and the faculty of each through courses taught by video broadcast and by inter-campus visits. Many research projects are collaborative efforts between faculty and students across the two locations. All PhD students experience a required Clinical Rotation course much of which is given at the Medical

Center in Winston-Salem. Students successfully completing a graduate program in SBES will receive a joint degree from Virginia Tech and Wake Forest University. The diploma displays the names and seals of both institutions.

SPECIAL FACILITIES

On the Blacksburg campus SBES occupies Kelly Hall, on Stanger Street with approximately 30,000 sq. ft. of laboratory space designed specifically for cutting-edge biomedical research. Also available to graduate students at Blacksburg are the superior facilities of the Veterinary College (VMRCVM) which is part of the SBES alliance, the Virginia Bioinformatics Institute, located on the VT campus, and most recently the Virginia Tech Carilion School of Medicine and Research Institute (VTCRI) located in Roanoke, VA. At Winston-Salem SBES students have access to top quality research resources through the Wake Forest University School of Medicine and its affiliation with North Carolina Baptist Hospital, one of the finest in the country. Additionally, SBES has ties to the Wake Forest Institute for Regenerative Medicine (WFIRM), an international leader in bringing cell and tissue engineering discoveries to clinical therapies. The WFIRM and other research groups are part of a 200-acre biotechnology initiative at the Piedmont Triad Research Park which will be the largest urban research park of its kind in the nation.

Advanced Neuroscience Imaging Research Core (ANSIR) [Winston-Salem]

The Advanced Neuroscience Imaging Research (ANSIR) Laboratory is a research group based in the Department of Radiology of Wake Forest University School of Medicine. The lab is devoted to the application of novel image analysis methods (e.g. diffeomorphic registration, machine learning, graph theory, ASL) to research studies, as well as to robust clinical translation of these techniques. The lab also maintains a fully automated functional and structural image processing pipeline supporting the image storage and analysis needs of a variety of scientists and imaging studies at Wake Forest. Website Here

Bio-imaging Systems Lab [Blacksburg]

The purpose of the Bio-imaging Systems Lab is to develop technologies to accelerate the use of imaging and image analysis in biomedicine. An important part of this goal is communicating with the clinical and basic scientists who benefit from our work. website here

Bioanatomic Imaging and Treatment Program [Winston-Salem]

The Bioanatomic Imaging and Treatment (BAIT) Program is a clinical and research program at North Carolina Baptist Hospitals and Wake Forest University School of Medicine. BAIT clinical and basic research focuses on the uses of bioanatomic imaging and treatment for patients who have cancer, on understanding the biological mechanisms of cancer as can be seen with imaging, and on radiation treatment responses. Our scientific programs include image-based clinical trials and basic research in imaging science and radiation treatment physics. website here.

Bioelectromechanical Systems Lab [Blacksburg]

Bioelectromechanical Systems is a cross disciplinary field that combines engineering and science from the nano to the macro level. In our laboratory we have developed technology for tissue viability detection, picoliter sample management, and imaging for molecular medicine. We have developed three inexpensive solutions that use electrical feedback to perform complex procedures in biotechnology with precision and control. Through this engineering approach, we have established robust methods for single cell analysis, selective cell concentration, and cancer therapy. website here.

Biomedical Imaging Division [Blacksburg and Winston-Salem]

The mission of the Biomedical Imaging Division is to define and advance biomedical imaging frontiers, optimize clinical / preclinical potentials, and train the next generation of imaging scientists and engineers. It consists of two x-ray imaging laboratories; the SBES Advanced Multi-scale CT (SAM-CT) lab and the X-ray Systems Lab. The two labs house four commercial CT imaging systems and two custom-built CT imaging systems. Together they provide image resolution from 500 micrometers down to 50 nanometers, and sample size from 100 micrometers up to 100 millimeters, enabling biomedical discovery on a range of objects from a single cell to an adult rat. website here

Center for Biomolecular Imaging [Winston-Salem]

The Center for Biomolecular Imaging (CBI) is a multi-technology Medical School facility comprised of state-of-the-art imaging modalities. Its purpose is to support imaging research while facilitating multidisciplinary research. Part of its mission is to change the imaging research paradigm from pathoanatomy to imaging opportunities related to physiologic/functional imaging and molecular imaging. Website Here

Center for Injury Biomechanics [Blacksburg and Winston-Salem]

The Center for Injury Biomechanics performs research investigating human tolerance to impact loading. The application of this research includes automobile safety, military restraints, and sports biomechanics. The Center combines experimental testing with anthropomorphic test drivers and computational modeling in order to develop human impact injury criteria. Website Here

Center for Nanotechnology and Molecular Materials [Winston-Salem]

Nanotechnology is engineering at the molecular level. At Wake Forest University's Nanotech Center the revolutionary principles of nanotechnology are being used to address the pressing needs of human society from health care to green energy technologies. The Nanotech Center is a shared resource serving academic, industrial, and governmental researchers across the region. We welcome researchers from any discipline who wish to explore uses of nano-materials and nanotechnologies in their work. Website Here.

Center for Regenerative Medicine [VT-Carilion, Roanoke]

The research of the lab is on the subunit proteins of gap junctions -- connexins. Our work encompasses both basic and practical/translational aspects. In basic research we study cellular and molecular mechanisms of the carboxyl terminal domain of Cx43 in regulating gap junction remodeling and electrical conduction in the normal and arrhythmic heart. In our more practically oriented work, we focus on Cx43 assignments in wound healing, scarring, and regeneration. The lab is developing a platform of drugs targeting Cx43 function. website here

Chappell Lab [VT-Carilion, Roanoke]

Pericytes are cells that wrap around blood vessels to maintain their stability and regulate their diameter through vasomotion. Disruptions in pericyte contribution to the vascular wall can lead to disease progression including diabetic retinopathy. Dr. Chappell and his lab use computational modeling approaches in conjunction with real-time imaging of ex vivo and in vitro models of blood vessel formation to understand pericyte behavior during blood vessel formation in health and disease. Understanding the mechanisms behind pericyte recruitment and investment will provide rationale and guidance for targeting pericyte-endothelial cell interactions for therapeutic benefit.

Comprehensive Cancer Center [Winston-Salem]

Because research brings hope, basic science, clinical and public health researchers at the Comprehensive Cancer Center of Wake Forest University collaborate to answer complex questions that lead to promising new treatments and therapies. The research programs are structured to optimize multidisciplinary and translational research. Our researchers work together to take the most promising discoveries from the laboratory into the clinic for the benefit of our patients and the cancer community as a whole. Website here.

Computational Bioinformatics & Bio-imaging Laboratory [Northern Virginia]

We are electrical and computer engineering researchers by training who have developed a great interest in multiscale, computational, integrative, and system biomedical sciences, mainly inspired by our curiosity about the process of discovery. We enjoy close collaborations with biologists and physicians, and these partnerships provide us with the opportunities to learn new things, to ask new questions, and to pursue new discoveries. Website Here

Crash Injury Research & Engineering Network (CIREN) [Blacksburg and Winston-Salem]

The Crash Injury Research and Engineering Network (CIREN) is a multi-center research program involving a collaboration of clinicians and engineers in academia, industry, and government. Together, they are pursuing in-depth studies of crashes, injuries, and treatments to improve processes and outcomes. CIREN's mission is to improve the prevention, treatment, and rehabilitation of motor vehicle crash injuries to reduce deaths, disabilities, and human and economic costs. Website here

Human Neuroimaging Laboratory [VT-Carilion, Roanoke]

The Human Neuroimaging Laboratory (HNL) is part of the Virginia Tech Carilion Research Institute, located in Roanoke, Virginia. Research projects cover a wide variety of fields, including neuroscience, psychology, political science and economics. Particular areas of interest are hyperscanning (a means of exploring brain activity that underlies human social interactions), social neuroscience, neural circuitry of valuation and decision-making, and disruptions of such processes associated with developmental and psychiatric illness. The HNL serves as the primary imaging facility of the VTCRI. Website here

Institute for Critical Technology and Applied Science (ICTAS) [Blacksburg]

The Institute for Critical Technology and Applied Science supports and promotes cutting edge research at the intersection of engineering, science and medicine. ICTAS stimulates, catalyzes, and promotes growth of research at Virginia Tech. ICTAS provides a collaborative atmosphere designed to stimulate and promote creativity, a place where intellectual capacity can be explored and challenged to reach areas previously explored in isolation. Website Here

Kelly Lab [VT-Carilion, Roanoke]

Research in the Kelly Lab at VTCRI focuses on developing innovative methodologies to study complex biological machinery. Combinations of structural and functional tools are used to understand how signaling pathways influence human development and disease. Cryo-Electron Microscopy (EM) allows us to peer into the world of cells and molecules around us. Affinity Capture technology is an innovative platform for visualizing molecules in action. We are developing this approach to transform our vision of the molecular world. Website here

Kevin P. Granata Biomechanics Lab [Blacksburg]

Our mission is to investigate the dynamics and neuromuscular control of human movement, and to train scientists to become leaders in the fields of musculoskeletal, sports and orthopaedic biomechanics. The primary focus of the research conducted in the Granata Lab is injury prevention. Projects in the lab fall into 3 main categories: Athletic Injury Prevention, Lower Extremity Joint Arthritis and its impact on Movement, and Alterations to Movement that result from injury and pathology.

LaConte Lab [VT-Carilion, Roanoke]

Research in the LaConte Lab is devoted to advanced neuroimaging acquisition and data analysis approaches, aimed at understanding and rehabilitating neurological and psychiatric diseases. A major focus of the lab in an innovation in functional magnetic resonance imaging (fMRI) which we developed and call "temporally adaptive brain state" (TABS) fMRI. The inception of TABS arose from two major recent advances in neuroimaging, namely 1) the recognition that multi-voxel patterns of fMRI data can be used to decode brain states and 2) the emergence of real-time fMRI as a viable tool for neurofeedback. website here.

Laboratory for Biomaterials and Tissue Engineering [Blacksburg]

Our research focuses on the development of model tissue constructs or functional tissue units and the study of cell-substratum interactions. A primary goal is to design tissue constructs that mimic the native structure of tissues in-vivo and to systematically probe cellular response to a variety of cues. This involves the fabrication of bio-compatible scaffolds and templates, and more importantly tailoring surface and bulk properties. Another research interest of our group is to quantify cell-substratum interactions. Specifically, our studies focus on how chemical and mechanical properties of an underlying substratum affect cellular motility and contractility. Website Here

Laboratory for Complex Brain Networks [Winston-Salem]

The LCBN is a Wake Forest Baptist Health neuroscience and neuroimaging research facility located on the Medical Campus of Wake Forest University. It consists of an association of scientists located at universities, laboratories and research centers around the world that focus on imaging technology and emergence in complex systems. The primary focus of the laboratory is the development of innovative ideas, methods, and technologies for systematic understanding of emergence in dynamic complex systems such as the brain. Through the development and use of network science methods, the work of the LCBN offers a means to quantify and analyze networks of complex systems. Website here

Laboratory for Fluid Dynamics in Nature [Blacksburg]

The research at the Laboratory for Fluid Dynamics in Nature (FiNLab) is focused on two main themes: fluid flows in nature, and advanced computational methods for fluid flows. The natural systems studied at FiNLab range from insect respiratory flows, which occur at the microscale, to planetary atmospheric flows with length scales on the order of tens of kilometers. There is an emphasis on biomimetics for efficiency, resilience, and sustainability, on high performance computing, and on advanced multiscale computational modeling website here.

Laboratory of Vascular Biology [Blacksburg]

There are three main focus areas involved in the research efforts of the vascular biology lab: a) Pro-oxidative and pro-inflammatory mechanisms of human chronic vascular disease, such as stroke, atherosclerosis, Alzheimer's disease, and tumor angiogenesis/metastasis. b) Biomedical applications of nanotechnology: novel therapeutic explorations for brain injury and cancer progression by vascular endothelial cell targeting of bioconjugated nanoparticles. c) Cellular and molecular signaling mechanisms of the vascular responses to shear stress. Website Here

MD3: Medical Devices and Drug Delivery Lab [Blacksburg]

The MD3: Medical Devices and Drug Delivery Lab works in a highly multi-disciplinary environment to solve problems in cancer diagnosis and treatment through the combination of existing and emerging technologies. In our laboratory, we are interested in developing needle-based medical devices for cancer detection and treatment in real time. We are also interested in developing sustainable non-toxic nanopharmaceuticals that are designed and validated to be safe in the environment and in humans. Website here

Mechanics of Soft Biological Systems Lab [Blacksburg]:

The Mechanics of Soft Biological Systems Laboratory focuses on characterizing the mechanical properties of biological structures ranging from lipid bilayers to collagenous tissues in vertebrates and chitin-based tissues in invertebrates. The common theme of the lab is the study of the relationship between complex structures and mechanical behavior of biological system, using approaches that combine physically-sound theoretical models with novel experimental methods. website here.

Micro/NanoScale Biotic/Abiotic Systems Engineering (MicroN BASE) Laboratory [Blacksburg]

Our lab focuses on interfaces between biological and synthetic systems (or bio-hybrid-engineering). The research interests cover the study of micro-nano-robotics, nanotechnology, bio-nano interface, and biophysics of bacteria motility, chemotaxis and adhesion. There are two main broad categories of activities: (1) developing bio-hybrid engineered systems (biomicrorobots) in which biological components are utilized for actuation, sensing, communication, and control. (2) studying mechanisms of adhesion, motility and sensing in cells or unicellular microorganisms. website here

Microfluidics Lab [Blacksburg]

Our research is concerned with the new science and technology generated by applying micro/nanofabricated structures and devices to biological studies and biosensors. One emphasis in our research is to develop high-throughput microfluidic tools to manipulate and analyze single cells and extract biological information. Another thrust in the group is on developing flow-through electroporation for efficient gene delivery into cells. Our ultimate goal is to apply this technique to create genetically modified cells for cancer immunotherapy, stem cell therapy and tissue regeneration. website here.

Nanostructured Biopolymer Engineering Lab [Blacksburg]

Biomaterials are an essential tool that provides the basis for bioengineered devices, growing and delivering cells, developing functional tissues, and engineering whole organs. Natural biopolymers that self-assemble on the nano scale have the potential to provide native cellular environments that facilitate the directed behavior of cells. Research conducted by the Nanostructured Biopolymer Engineering Lab makes use of naturally derived structural proteins for biomaterials development. Using primarily keratin proteins, Dr. Van Dyke's research group creates matrices and scaffolds used for tissue engineering and trauma applications, and studies their fundamental characteristics such as molecular self-assembly and structure-function relationships.

Occupational Ergonomics & Biomechanics Lab [Blacksburg]

The Occupational Ergonomics and Biomechanics Laboratory conducts work in theoretical and applied ergonomics, occupational biomechanics, and work physiology, primarily relating to work site, workstation, and equipment evaluation and design. Specifically, research is focused on biomechanics of the human body (modeling, strength, motions, and working postures); human engineering of systems, equipment, tools, workstations and work tasks, and ergonomic design for safety, efficiency, and performance. Website Here

Orthopedic Mechanobiology Laboratory [Blacksburg]

Our research lab utilizes biomechanical, imaging and molecular biological approaches to study mechanisms of tendinopathy. Particular emphasis is placed on examining the therapeutic benefits of mechanical stimulation in tendon healing as well as understanding the roles of ADAMTS enzymes in aberrant extracellular matrix remodeling of skeletal tissues.

Quantitative Imaging Lab [Winston-Salem]

The focus of the Magnetic Resonance Quantitative Imaging Lab is to develop quantitative imaging techniques with magnetic resonance imaging to answer scientific questions and improve patient care. These imaging techniques are being used in numerous collaborative projects ranging from temperature mapping to evaluate new hyperthermia treatments with multiwalled carbon nanotubes, to measuring cerebral blood flow for improving patient care, to using phase contrast imaging to measure vascular stiffness. Traditional medical imaging has largely been qualitative, that is, the intensity of a pixel is arbitrary and only conveys relative information when comparing pixels. In contrast, the pixel intensities in quantitative images are directly proportional to a physical parameter (temperature, density, blood flow, velocity, concentration, etc.). This type of imaging provides repeatable, observer-independent measure of physical quantities.

Socha Lab: Comparative Biomechanics & Bio-Inspired Engineering [Blacksburg]

Our lab studies the biomechanics of motion in animals, conducting integrative research that crosses traditional boundaries of engineering and biology. Currently, two broad themes of our research center around gliding flight in vertebrates and internal fluid flows in invertebrates. We aim to understand animal movements both for fundamental understanding of animal physiology, ecology and evolution, and as inspiration for novel engineering applications. website here.

T. M. Murali Laboratory [Blacksburg]

The functioning of a living cell is governed by intricate networks of physical, functional, and regulatory interactions among different types of molecules. Recent experimental advances have yielded unprecedented insights into the structure of these interaction networks and into patterns of molecular activity (mRNA, proteins, and metabolites) in response to different conditions. The ultimate goal of my research is to build phenomenological and predictive models of these networks by developing approaches that investigate the relationships among the molecules in a cell, how these elements are organized into functional modules, how these modules interact with each other, and how different modules become activated or de-activated in various cell states. Website here.

The Hall Lab: Basic and Applied Nanobiotechnology [Winston-Salem]

We are an interdisciplinary group of scientists using the tools of nanotechnology to study biology at the smallest scale. Our goals are to learn more about the basic functions and interactions of biological molecules and to use what we find to achieve new capabilities with biomedical implications. In pursuing this goal, we bring together aspects of physics, engineering, molecular biology, and many other disciplines. Website here.

Tissue Engineering Lab [Blacksburg]

The Tissue Engineering Laboratory explores methods for developing engineered bone and ligament tissues using a combination of novel biomaterials, adult stem cells, and advanced bioreactor technologies. Some specific issues being addressed include; elastomeric polyurethane biomaterials, electrospun fiber meshes with tunable mechanical and topographical properties, mechanotransduction and cell signaling in dynamic bioreactors, quantitative imaging of developing tissues, and fluid mechanics and mass transport. Website Here

VT MEMS Laboratory [Blacksburg]

Research at VT MEMS Lab currently centers on the development of three-dimensional micromachining techniques, micro gas analyzers for environmental and healthcare applications, biochips for cell analysis, cancer diagnosis, and cancer treatment monitoring, and biochips for pathogen detection in water. MEMS technology is used along with various microscopy techniques to determine mechanical and electrical signatures of cells under controlled microenvironments. Additional major thrust areas of research include micro analytical chemistry and micro/nano fabrication. Website here

Verbridge Laboratory for Integrative Tumor Ecology (LITE) [Blacksburg]

The LITE lab's main thrust is in using the tools of micro/nano technology and tissue engineering to study the role of cell-microenvironment interactions in cancer. One aim is to develop new engineering tools and in-vitro culture platforms to illuminate cellular response to microenvironmental cues (i.e. cell-cell, cell-matrix, chemical, electrical) and stresses (i.e. hypoxia, radiation, drug treatment) in a physiologically relevant 3-D context. website here.

Virginia Bioinformatics Institute (VBI) [Blacksburg]

VBI is a world-class research institute dedicated to the study of the biological sciences. by using bioinformatics and medical informatics, which combines transdisciplinary approaches to information technology and biomedicine, researchers at VBI create, interpret, and apply vast amounts of biological data generated from basic research to some of today's key challenges in the biomedical, environmental and agricultural sciences. The institute develops genomic, proteomic, and bioinformatic tools and databases to study genomes and diseases for the discovery of new vaccine, drug and diagnostic targets for humans and the species upon which they depend to improve our quality of life, health and security. website here

Virginia Tech - Carilion Research Institute (VTCRI) [Roanoke]

Research conducted at the Virginia Tech Carilion Research Institute (VTCRI) creates a bridge between basic science research at Virginia Tech and clinical expertise at Carilion Clinic and increases translational research opportunities for both partners. Research conducted by scientists at the institute is aimed at understanding the molecular basis for health and disease, and development of diagnostic tools, treatments, and therapies that will contribute to the prevention and solution of existing and emerging problems in contemporary medicine. Research areas of emphasis which presently align with areas of strength and active research at Virginia Tech include inflammation, infectious disease, neuroscience, and cardiovascular science and cardiology. website here.

WFSM Orthopedic Surgery Lab [Winston-Salem]

Orthopedic Surgery has numerous collaborative research projects with SBES faculty in many areas including: Hand/Upper Extremity/Microsurgery Sports Medicine Orthopedic Trauma and Foot & Ankle Surgery Total Joint Arthroplasty, Adult Reconstruction and Joint Preservation Surgery (Hip and Knee)

Wake Forest Institute for Regenerative Medicine (WFIRM) [Winston-Salem]

Ever since the first engineered skin tissue was transplanted in 1981, the potential of regenerative medicine has captured the imagination of physicians and scientists worldwide. Technologies for engineering tissues are developing rapidly, with the ultimate goal of delivering new therapies into patients as safely and efficiently as possible. Our current research focuses on a wide range of engineered tissues with the aim of making a lasting impact on conditions ranging from diabetes to heart disease. In addition, we're working to apply the science of regenerative medicine to battlefield injuries and are working to help solve the shortage of donated organs available for transplant. As a result of our preliminary successes, tissue engineering and cellular therapy programs now span multiple organ systems. Website Here

X-Ray Systems Lab [Blacksburg]

The X-ray Systems Lab aims at developing novel medical imaging technologies for biomedical and bioscientific discovery, radiological diagnosis, and medical intervention. Directed by Dr. Guohua Cao, the lab focuses on novel x-ray sources, detectors, and system engineering. Our research activities are interdisciplinary and translational, and interface between basic sciences, translational development, and clinical applications. website here.

DEGREES OFFERED

PhD Degree

Offered In (Wake Forest, Blacksburg, Roanoke)

TOEFL

TOEFL: (100.0)

IELTS

IELTS: Band: (7.0)

The Ph.D. degree requires a minimum of 90 total credit hours beyond the baccalaureate. Additionally, a dissertation must be written and defended before a 5-person committee. The Ph.D. plan of study is due by the end of the third semester of study registered as a Ph.D. student. All coursework must be 5000-level and above (VT campus) and 600-level and above (WFU campus). The distribution of required hours can be: 40 - 55 credit hours of research (7994-level only, VT) 35 - 50 course credits Specific course of study requirements are as follows:Course Requirements for BME Ph.D. Program:The Doctor of Philosophy degree in Biomedical Engineering must include the following minimum requirements: 15 credits of engineering courses (BMES or from any engineering department) to include the required courses, Quantitative Cell Physiology and Quantitative Organ Systems Physiology. 6 credits of graduate level mathematics, only 3 of which may be in statistics (see approved lists on website for each campus location) 3 credits of life science coursework from approved courses and/or departments on each campus (see website/handbook for details) 2 credits from the required BMES 6064 Clinical Rotation (available only to PhD candidates) 9-24 credits in elective coursework, remainder of hours up to 90 in research Ph.D. students must complete training in Ethics, required by the Virginia Tech and Wake Forest Graduate Schools, which must be noted on the plan of study. Students at the Virginia Tech campus must also complete training in Diversity, required by the Virginia Tech Graduate School. See the SBES Graduate Handbook for details regarding implementation on each campus. Students are also required to enroll in and successfully complete the SBES Seminar course (BMES 5944 at VT and BMES 694 at WFU) for 6 semesters during their degree program.Ph.D. students must pass a Qualifying Exam no later than the end of the second year for students entering directly into the Ph.D. program or within one year of entering the program after completing the M.S. degree. ALL students are expected to attend and participate in the annual Research Symposium held each spring. See the SBES Graduate Handbook for details regarding participation requirements. Ph.D. students may elect to earn an M.S. degree "along the way" as an intermediate milestone to the Ph.D. with the prior approval of their advisor. They must file an M.S. plan of study at the end of the second semester of study, and write and defend a thesis. Please refer to the SBES Graduate Handbook on www.beam.vt.edu for details regarding all degree requirements. The GRE is not required for applicants to this program!

MS Degree

Offered In (Wake Forest, Blacksburg, Roanoke)

TOEFL

TOEFL: (100.0)

IELTS

IELTS: Band (7.0)

The Master of Science degree requires a minimum of 30 total credit hours beyond the baccalaureate which must consist of: 6 - 9 credit hours of research (5994-level only, VT) 21 - 24 course credits Specific course of study requirements are as follows: Course Requirements for BME M.S. Program: The M.S. degree in Biomedical Engineering must include the following minimum requirements: 9 credits of engineering courses (BMES or from any engineering department) to include the required courses, Quantitative Cell Physiology and Quantitative Organ Systems Physiology. 3 credits of graduate level mathematics which can be either pure math or statistics from approved lists on each campus (see website) 3 credits of life science from approved courses and/or departments on both campuses (see website/handbook for details) 6 - 9 credits in elective courses, the remainder up to 30 in research All coursework must be at the 5000-level or higher (Blacksburg) and 600-level or higher (Wake Forest). M.S. students must also enroll in and successfully complete the SBES Seminar course (BMES 5944 at VT and BMES 694 at WFU) for 4 semesters during their degree program. M.S. students must complete training in Ethics and Diversity, required by the graduate schools, which must be noted on the plan of study. See the SBES Graduate Handbook for details regarding implementation at each campus. A written plan of study is to be submitted at the end of two semesters of graduate study. All M.S. students write and defend a thesis. There is no non-thesis M.S. degree in SBES. ALL students are expected to participate in the annual SBES Research Symposium held each spring, and are required to do an oral research presentation at least once before they graduate. Please refer to the SBES Graduate Handbook on www.beam.vt.edu for details regarding all degree requirements. The GRE is not required for applicants to this program!

GRADUATE COURSES (BMES)

BMES 5004:

BME Ethics & Professional Development

Socialization to the graduate student environment. Strategies for professional development and ethical standards in Biomedical Engineering. Virginia Tech's ethical and academic values. Graduate Honor Code including plagiarism and scholarly citations. Ethical standards in academics. Ethical standards in biomedical research and reporting misconduct. Scientific communication across boundaries. Pre: Graduate standing in BME. Pass/Fail only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5024 (BMVS 5224):

Biomedical Engineering and Human Disease

Comprehensive overview of a variety of human diseases, including, neurological disorders, cardiovascular disease, infectious disease, and cancer, designed primarily for graduate students majoring in engineering and other related areas who have a long-term academic and professional goal in the field of biomedical engineering and life sciences. Introduction to state-of-the-art biomedical engineering approaches used for the study of early detection/diagnosis, treatment and prevention of human disease. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5044 (CHE 5044) (BSE 5044):

Engineering Mathematics

Introduction to numerical solutions of partial differential equations using the finite element method in one-, two-, and three-dimensions with direct relevance to chemical engineering, biological systems engineering and biomedical engineering and sciences. Partial differential equations and ordinary differential equations using finite differences, model parameter sensitivity analysis, optimization, and data analysis. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5054:

Quantitative Cell Physiology

Mathematical modeling, simulation, quantitative description of cell physiology and control. Numerical simulation of cellular physiologic processes including reaction kinetics, inhibition and cooperativity, passive transport, facilitated and carrier-mediate reaction kinetics. Cell resting membrane potential, and nerve and muscle tissue. Modeling of neural cell processes including voltage-gated channels, neurotransmitter kinetics, and postsynaptic cell membrane potentials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): BMES 5044

BMES 5064:

Quantitative Organ Systems Physiology

Mathematical modeling, simulation, quantitative description of organ physiology and control. Numerical simulation of cardiovascular physiologic processes including regulation of cardiac output, the baroreceptor - stroke volume model, venous return, and closed-loop control. Respiratory ventilation mechanics, gas exchange, pulmonary circulation, alveolar-capillary diffusion, and respiratory ventilation control. Nephron countercurrent mechanism and hemodialysis. Modeling of endocrine system functions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): BMES 5044

BMES 5074:

Biomedical Research Design

Design and analysis of research in the biomedical engineering fields. Ethical considerations. Experimental planning. Implementation of data collection plans. Statistical data analysis and interpretation of statistical results. Design and execution of clinical trials. Deployment of epidemiological studies. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5124 (ESM 5224):

Advanced Musculoskeletal Biomechanics

Skeletal anatomy and mechanics. Muscle anatomy and mechanics. Theory and application of electromyography. Motion and force measuring equipment and techniques. Inverse dynamics modeling of the human body. Current topics in musculoskeletal biomechanics research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5154G:

Advanced Commercialization of Biomedical Engineering Research

Commercialization process applied to translational research. Regulatory aspects of biomedical engineering products and technologies (e.g. devices, diagnostics, drugs, biologics). Intellectual property, technology transfer processes, clinical trial design, commercialization of university research, modeling of development costs (e.g. cash flow and revenue projections). Small business startup approaches. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5164:

Advanced Impact Biomechanics

A review of impact biomechanics and critical investigation of the impact response of the human body. Participants will study the dynamic response of the head, neck, chest, abdomen, upper extremities, and lower extremities. Real world examples from automobile safety, military applications, and sport biomechanics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ME 3504 (UG), ME 3614 (UG)) OR (ESM 3054 (UG), ESM 3124 (UG)) OR (ME 3504, ME 3614) OR (ESM 3054, ESM 3124)

Corequisite(s):

BMES 5174 (ME 5174):

Biomechanics of Crash Injury Prevention

Principles of design and analysis of crash injury prevention methods in vehicle crashes. The course encompasses three major focus areas for occupant protection in crashes: crash energy absorption in (1) the vehicle structure, (2) the occupant, and (3) the occupant restraints. Topics include the biomechanics of impact injury, analysis of occupant response in crash tests, vehicle crash kinematics, modeling of vehicle impact response, modeling of human impact response, and occupant restraint design. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5184:

Injury Physiology

Introduction to the physiology of injury. Focus on the pathophysiology, mechanisms, and outcomes of injury in humans. Explores injury physiology at the organ, tissue, and cellular level. Topics include physiology of injury to the peripheral and central nervous systems, the musculoskeletal system, the pulmonary system, the abdomen, and the eye. Includes the injury physiology of adults as well as the special populations of children, pregnant females, and the elderly. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): BMES 5054

BMES 5204 (ME 5204):

Laboratory Techniques in Injury Prevention

Human surrogate biomechanical impact testing. 3-D rigid-body kinematics, kinetics, properties of deformable materials, servosled testing. Injury prediction and mitigation for transport systems. Transportation restraint system design. Instrumentation, data acquisition, and signal processing techniques of impact biomechanics. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5214 (ISE 5614):

Human Physical Capabilities

Focuses on the modeling, analysis, and evaluation of industrial workplaces with emphasis on the physical demands placed on and the capabilities of workers. Topics covered include: physiology, anthropometry, bioinstrumentation, and biomechanics. Students will learn and apply a range of contemporary analytical and assessment methods. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5234:

Advanced Vehicle Safety Systems

Emerging challenges, applications, technology, tools, and agile management methods. Developing and evaluating safe next-generation ground transportation systems. Human and machine interactions. Epidemiological, empirical, and naturalistic approaches. Controlled test-track experiments. Design and development of advanced vehicle safety features. Collect, process, analyze, and interpret data. Driver behavior monitoring, collision avoidance, sensor, connected, and automated driving systems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5304 (CHE 5304):

Biological Transport Phenomena

The fundamental principles of mass transport phenomena will be introduced and applied to the characterization of transport behavior in biological systems (e.g., cell, tissues, organs, people). Topics will include active, passive, and convective molecular transport mechanisms. These fundamentals will be used to develop analytical and predictive models that describe phenomena such as oxygen transport, kidney function, systemic drug delivery, and design of extracorporeal devices. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHE 3114 (UG) OR CHE 3114, (CHE 3044 (UG) OR CHE 3044 OR CHE 3144 (UG) OR CHE 3144) OR (ME 3304 (UG) OR ME 3304, ME 3404 (UG) OR ME 3404)

Corequisite(s):

BMES 5304G:

Advanced Biological Transport Phenomena

Engineering analysis and predictive modeling of heat and mass transport in biological systems (e.g., tissues, organs, organisms, and biomedical devices). Examination of processes that involve conduction, convection, diffusion, generation/ consumption. Application of analytical and computational methods to solve differential equations that describe unsteady and/or multi-dimensional transport. Topics include oxygen transport, drug delivery, pharmacokinetic analysis, kidney function, blood perfusion, cryopreservation, and hyperthermia. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5305:

Biomechanics of the Cardiovascular System

5305: Mechanics of the heart, arterial blood vessels and microcirculation; history of the circulation; anatomy and physiology of the heart; mechanics of cardiac contraction; cardiac fluid mechanics; work, energy, efficiency of cardiac function. 5306: Rheology of blood; hematology; elasticity of blood vessel walls; transport processes; control of the circulation; mathematical analysis of pulsatile blood flow and pulse-wave propagation through small arteries, capillary beds and extra-corporeal devices.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5306:

Biomechanics of the Cardiovascular System

5305: Mechanics of the heart, arterial blood vessels and microcirculation; history of the circulation; anatomy and physiology of the heart; mechanics of cardiac contraction; cardiac fluid mechanics; work, energy, efficiency of cardiac function. 5306: Rheology of blood; hematology; elasticity of blood vessel walls; transport processes; control of the circulation; mathematical analysis of pulsatile blood flow and pulse-wave propagation through small arteries, capillary beds and extra-corporeal devices.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5314:

Introduction to Regenerative Medicine

Current state of the field of regenerative medicine with specific emphasis on the technological challenges that limit the efficacy and clinical translation of engineered tissues and therapies. Life science (e.g., call biology, organ physiology, biochemical methods) and engineering perspectives (e.g., stem cells, biologically-inspired materials, gene therapies) Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5324:

Advanced Topics in Regenerative Medicine

Advances in regenerative medicine, gene therapy, stem cell biology/therapy, biomaterials, tissue engineering, and the physiology of the major organ systems in both health and disease. Problem solving novel approaches to overcome limitations to engineer anatomically accurate and fully functional organ replacements to solve the unmet clinical need for donor organs.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BMES 5314

Corequisite(s):

BMES 5434:

Polymeric Biomaterials

Topics include polymer design and processing, inflammatory responses to polymers, interaction of blood with polymeric materials, and the effect of mechanical, chemical, and surface properties of polymers on cells. The culmination of this course will provide students with the knowledge to successfully design polymer-based biomaterials, drug-delivery devices, and bio-implants. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5514 (ME 5714):

Digital Signal Processing for Mechanical Measurements

The fundamentals of digital signal processing of data experimentally obtained from mechanical systems will be covered. Attention will be given to the data acquisition, A/D conversion, aliasing, anti-aliasing filtering, sampling rates, valid frequency ranges, windowing functions, leakage, and various transform methods. Special attention will be given to random, transient, and harmonic function data processing. Various methods of estimation of the frequency response function (FRF) will be explored. The estimation methods will be assessed as to their impact on FRF estimation errors.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5525 (ECE 5605):

Stochastic Signals and Systems

Engineering applications of probability theory, random variables and random processes. Time and frequency response of linear systems to

random inputs using both classical transform and modern state space techniques.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 4714 (UG) OR STAT 4714
Corequisite(s):

BMES 5534:

Advanced Computational Methods and Modeling for Biomedical Applications

Methods of biomedical computational model development, solutions of ordinary and partial differential equations in mathematical models for biomedical applications, and current topics in biomedical modeling. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMES 5574:

Advanced Biomaterials

Materials for medical applications. Basic material types and properties, functional uses of materials in medical applications, and tissue response mechanisms. Integrated design issues of multicomponent material design in prosthetic devices for hard and soft tissues, orthopedics, cardiovascular, and drug delivery applications. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMES 5604:

Cancer Detection and Therapeutics

Complexities and characteristics of cancer. Cancer progression and metastasis. Methods of tumor modeling. Cancer diagnosis methods including biopsy, pathology, and medical imaging. Cancer therapy methods including surgery, transplantation, energy-based therapies, and chemotherapeutic and immunotherapy agents. Decision-making strategies for tumor therapy. Case studies of cancer patients. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMES 5614:

Multiscale Cancer Engineering

A multidisciplinary, multiscale approach to analyzing cancer etiology, progression, detection, and therapy. Traditional and emerging methods of analyzing biomolecular aspects of cancer. Tumor microenvironment modeling and analysis. Physical oncology-inspired cancer therapy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BMES 5044
Corequisite(s):

BMES 5714:

Biomedical Microdevices

The goal of this course is to build the foundation necessary for engineering research in micro- and nano- biotechnology. The course will be broken down into four major area: micro- and nano- fabrication techniques, the fundamentals of microfluidics, micro- and nano- particle manipulation, and engineering aspects of cells and their membranes. The culmination of the course will provide students the knowledge required to create biomedical micro- and nano- devices with a focus on the unique physics, biology and design aspects at these scales. Students will be expected to know undergraduate engineering, physics, and calculus. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMES 5724:

Biomedical Nanoengineering

Major concepts in the design, production, and utility of micro- and nanotechnologies in biomedicine. Critical instrumentation, strategies for fabrication at the micro- and nanoscale, relevant nanoscale materials, engineering principles, and practical applications to biomedicine. Designed primarily for graduates who have a long-term academic and professional goals in the fields of biomedical engineering and biotechnology. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5764 (ME 5764):

Modeling MEMS and NEMS

Modeling MEMS and NEMS is about the construction, analysis, and interpretation of mathematical and computational models microelectromechanical and nanoelectromechanical systems (MEMS and NEMS). A goal throughout the course will be to develop a physical intuition for the fundamental phenomena at these small scales. The material covered will be broad and multidisciplinary including: dimensional analysis and scaling; a review of continuum mechanics; fluid dynamics, elasticity, thermal transport and electromagnetism at the micro and nanoscales; the modeling of a variety of new MEMS/NEMS devices; and approaches beyond the continuum theory including stochastic and deterministic methods. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BMES 5944:

Seminar

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

BMES 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BMES 6064:

Clinical Rotation

The course gives the student both a broad view of the use of engineering principles in medicine and general clinical care, together with an in-depth study of a particular aspect of medicine under the direct supervision of a physician. The student is allowed to observe the operation and maintenance of various clinical modalities, systems, and devices under the guidance of a working engineer or technician. The student participates in clinical rounds and image reading sessions to gain insight into the actual operation and needs of departments using medical imaging modalities. Pre: BME Ph.D. graduate students who have finished first year of study.

Credit Hour(s): 2

Lecture Hour(s):

Instruction Type(s): Lab

Instruction Type(s): Lab

Prerequisite(s):

Corequisite(s):

BMES 6164 (ESM 6164):

Computational Modeling in Impact Biomechanics

Dynamic modeling of the human body subjected to transient impact

loading. A combination of finite element analysis and multi-body simulated techniques. Utilized software packages with dynamic solvers. Applications include computer-aided design for automobile safety, sports biomechanics, and military restraint systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (BMES 5164 (UG) OR ME 5754 (UG)) OR (ESM 5014 (UG), ESM 5314 (UG))
Corequisite(s):

BMES 6174:

Advanced Human Modeling: Injury and Tissue Biomechanics

Serves as a continuation of Impact biomechanics (BMES 5164) and computational biomechanics (BMES 6164), which uses Madymo. Basics of the finite element method as it applies to high-rate phenomena. Focus will be on practical problems and the use of commercial codes for solving vehicle crashworthiness and biomechanics problems. Theory will be presented when it is useful for application to the problem. Real world examples from biomedical engineering, automobile safety, military applications, and sport biomechanics are used.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (BMES 5164 OR ME 5754), (BMES 6164 OR ME 6754)
Corequisite(s):

BMES 6194:

Advanced Movement Assessment

This course will expand on previous course work and provide a detailed understanding of the methods used to collect human movement data, how to process data and interpretation of data output for the assessment of human movement. This course will also evaluate current literature in the area of human biomechanics and the application of these techniques in research and clinical settings.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BMES 5124 OR ESM 5224
Corequisite(s):

BMES 6534:

Medical Health Physics

Physical and biological aspects for the assessment of and protection from ionizing radiation in medical environments. Biological consequences of human radiation exposure. Principles of ionizing radiation protection. Radiation exposure recommendations and regulations. Radiation shielding, design, personnel monitoring, and medical health physics instrumentation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BMES 6544
Corequisite(s):

BMES 6544:

Radiological Physics

Nature and fundamental concepts of ionizing radiation. Radiological principles, radiation interactions, production of radiation and radiation dosimetry. Radiation quantities, attenuation and stopping power, charged particle and radiation equilibria and radioactive decay. Photon interactions, charged and uncharged particle interactions, x-ray production and quality and dosimetry concepts. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BMES 6554:

Radiation Therapy Physics

The physics of radiation therapy through the use of radiation producing equipment, character of photon and electron radiation beams, radiation dose functions, computerized radiation treatment planning, brachytherapy, special radiation treatment procedures, quality assurance, and radiation shielding for high energy facilities.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BMES 6544
Corequisite(s):

BMES 6984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BMES 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BUILDING/CONSTRUCTION SCIENCE AND MANAGEMENT

Georg Reichard, Head

Professors: Brian Kleiner; Andrew McCoy; Georg Reichard; Walid Thabet;

Associate Professors: Abiola Akanmu; Thomas Mills; Annie Pearce; Tanyel Turkaslan Bulbul; Lu Zhang;

Assistant Professors: Kereshmeh Afsari; Philip Agee; Xinghua Gao; Nazila Roofigari-Esfahan; Alireza Shojaei kol kachi; Ruichuan Zhang;

Assistant Professor of Practice: Aleksandra Markovic Graff;

Collegiate Associate Professors: Josh Iorio;

Graduate Contact: bc-grad-admin-g@vt.edu

General Contact: bbratton@vt.edu

Building Construction: https://www.bc.vt.edu

Graduate Homepage: https://www.bc.vt.edu/graduate-programs

Graduate Guidebook: https://www.bc.vt.edu/graduate/msbc

At the Master's level, our Building Construction curriculum prepares students with the professional capabilities to critically address present and evolving needs of the construction industry. The Master of Science in Building Construction Science and Management (MS-BCSM) degree offers the opportunity for advanced study and research in specialized areas related to building design, construction, operations, and end-of-life-cycle, providing the basis for diverse career paths in the construction industry or an entry pathway into a doctoral program. While an undergraduate degree in Building Construction or related fields is not required, applicants must demonstrate relevant background, and professional experience in the construction industry is recommended. Applicants must also demonstrate the capability for undertaking advanced academic study. The Master of Science degree in BCSM requires a total of 32 credit hours of core courses and electives. Students may complete their degree requirements through independent investigation on a subject of their own interest through a faculty-supervised Thesis or Project & Report, or they may elect to complete their degree requirements through a final exit examination.

SPECIAL FACILITIES

Bishop-Favrao Hall (BFH) is a 31,600 square foot laboratory facility opened in 2008. It is the home of the Myers-Lawson School of Construction and the Department of Building Construction. BFH was designed to be used as a teaching tool. The structural elements that are usually hidden behind walls and ceiling panels in other buildings are exposed and labeled. That means students can clearly see the structures and systems they are studying in use. All public spaces and all offices have exposed ceilings to allow students and visitors to see the structural, mechanical, electrical, plumbing, fire protection, and electrical systems. The building was specifically designed with large open work spaces, conference and meeting rooms in order to foster a collaborative atmosphere, and flexible spaces available in this building range from two 100-person classrooms to 10-person conference rooms and reconfigurable studio spaces. The building is also home to multiple research labs and centers dedicated to inventing the future of the human-centered built environment. In addition to state-of-the-art research facilities, the building contains administrative, faculty, and graduate student offices.Bishop-Favrao Hall was made possible by numerous Building Construction alumni and friends, many of whom are noted on the donor wall located in the second floor lobby and on plaques around the building. The building is named after Richard Bishop and William A. Favrao. Address: 1345 Perry St. | Map Grid: K-3 Originally Built: 2007 | Abbreviation: BFH

ARCaDe Lab

The Automation & Robotics in Construction And Design (ARCaDe) Lab mission is to advance research and development in the next generation built environment technologies leveraging innovative solutions for design, construction, and operations of buildings and infrastructures. The ARCaDe Lab at Virginia Tech is involved in collaborative interdisciplinary research between the College of Architecture and Urban Studies and the College of Engineering to develop new solutions for the Architecture, Engineering, Construction, and Operations (AECO) industry. Key areas include integration of automation, robotic technologies and control systems, smart buildings and infrastructure, and cyber-physical systems.

BEST Lab

The Building Enclosure and Systems Technologies (BEST) Lab focuses on building science related topics around environmental building systems and enclosure systems and their interrelated thermal, hygrothermal, and acoustic performance, as well as performance aspects of mechanical, electrical, and lighting systems. This lab contains a full-scale building assembly test chamber as well as a variety of portable equipment for monitoring and measuring building conditions, including lighting, indoor air quality, as well as interior and exterior environmental conditions.

BuildLAB

The BuildLAB is a 6,000 square foot fabrication facility equipped for digital design and construction, this lab focuses primarily on wood and composite materials. The lab includes a full spectrum of portable and fixed conventional construction equipment, computer controlled additive and subtractive manufacturing tools, and a trailer-mounted field office and tool storage unit that can be used for projects off-site.

SFI Lab

The Sustainable Facilities & Infrastructure (SFI) Lab is a distributed lab that focuses on the study of sustainable technologies and systems in the built environment and the human systems with which they interact. The lab's equipment includes renewable energy feasibility assessment equipment, a portable audience-interactive charrette facilitator's kit, and a building condition assessment toolkit used to evaluate building performance and conditions in the field.

Smart Systems Lab

The Smart Systems Laboratory at Virginia Tech is a research group focused on basic and applied research on the design of decision support systems, cyber-learning and educational technologies with applications to workforce health, safety and technical training, smart education, smart buildings, and cyber-physical construction systems. These research efforts are largely interdisciplinary and draw upon tools from optimization, machine learning, statistics, sensing systems, and immersive technologies (virtual, augmented, and mixed reality) to embed intelligence into the design, construction, and maintenance of building and civil infrastructure systems.

VCHR

The Virginia Center for Housing Research (VCHR) -the official housing research center for the Commonwealth of Virginia, VCHR provides housing-related data services and analysis to local government, the Commonwealth, and other organizations.

VFRL

The Virtual Facilities Research Lab includes a 250 square foot visualization space as well as other spaces throughout Bishop-Favrao Hall. With a focus on Building Information Modeling (BIM), the lab explores challenges related to interoperability, design for safety, asset and facility management, and simulation.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

GRE

Verbal + Quantitative Reasoning: Minimum (305.0)

TOEFL

Paper: (620.0)

iBT: (105.0)

IELTS

Overall: Total (7.5)

The Master of Science in Building Construction Science and Management program consists of 32 credit hours of coursework including core courses and electives in construction-, design-, and business-related disciplines. Students may complete their degree requirements either through independent investigation on a subject of their own interest through a faculty-supervised Thesis or Project & Report, or through a final exit examination administered by the faculty. GRE Scores: GRE scores are recommended for students who wish to be considered for assistantship funding. TOEFL Scores: TOEFL scores are required of all international applicants who have not matriculated from an English-speaking university, due to the language-intensive nature of the program. Application Deadlines: All required documents must be received in the Graduate School by the Department's application deadline in order for the application to be complete. The Master of Science in Building Construction Science & Management (MS-BCSM) program accepts applications for fall terms only. (Active duty Military applicants can request a spring start.) The Department conducts general admission reviews and decisions within a month following the application deadline. Early reviews and admission decisions can be requested based on faculty recommendations. The deadlines below are the latest possible dates that an application will be considered. Funded Students: Students wishing to be considered for assistantship funding should apply no later than April 1st for Fall admission. Applications received before January 1st will be considered for early decision funding with decisions being available on January 15th. International Students: The application deadline for international M.S. applicants is April 1st. Most department decisions will be made by April 15th. Domestic Students: The application deadline for domestic M.S. applicants is July 1st. Decisions are anticipated to be made by July 15th.

Degree Concentrations:

Industry Track

The Industry Track offers opportunities for students who are interested in a career in the Architecture, Engineering, and Construction (AEC) industry after graduation. This track allows students to explore the key topics and issues that face the AEC industry, working closely with faculty and industry leaders. Students in this track may customize their course of study though their choice of elective courses both inside and outside the School of Construction, as well as through independent study working directly with faculty. Internships, executive shadowing experiences, and extracurricular opportunities round out the industry track experience, resulting in students who will be well-prepared to develop solutions to industry challenges and carry their companies forward into the future. Students will complete their degree in this track with a final oral exit exam administered by construction faculty.

Research Track

The Research Track offers a chance for students who wish to explore an industry problem at a deeper level, or who are considering further study at the doctoral level as part of their future career goals. This track offers both the basic coursework to equip graduates for a construction career as well as a chance to focus in detail on a problem of interest through a faculty-supervised one-semester project or two-semester thesis. Students in this track may customize their course of study using electives both inside and outside the Myers-Lawson School of Construction and will choose three faculty with complementary expertise to supervise their research in a problem area of interest to them. Students in this track have the opportunity to interact with industry through internships as well as working directly with companies to complete their research investigations. Graduates of this track will be equipped to pursue fast-track careers in industry or in academia through further study.

GRADUATE COURSES (BC)

BC 5024:

Cost Management of the Building Process

A study of cost management procedures applicable to the building process from concept through owner operations. Cost considerations in the decision process, concepts for monitoring and controlling costs, and the determination of accountability are examined. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BC 5114G:

Advanced Building Information Modeling In Design and Construction

Introduction to means and methods to enrich the geometric information of a building model with semantic data such as material, structural and performance values. Concept of interoperability in architecture, engineering and construction industry. Overview of approaches to information modeling such as Standard for the Exchange of Product model data (STEP), Industry Foundation Classes (ifc), Construction Operations Building Information Exchange (COBie), and Green Building XML (gbXML). Key concepts of object-oriented modeling and programming. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BC 5124G:

Advanced Digital Construction & Manufacturing

Explore and experiment with construction from the perspective of digital information, computer numerical control (CNC), and computer aided manufacturing (CAM) processes. Tools like 3D scanners, 3D printers, CNC manufacturing techniques, and others will be used in a lab setting intended to provide familiarity with these technologies and a sense of their benefits and limitations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

BC 5134:

Sustainable Facility Systems

Introduction to means, methods, and analytical practices associated with sustainability in the built environment. Best practices for sustainable projects in the areas of planning/development, site design, project management, energy and water conservation and efficiency, green building materials, and indoor environmental quality. Analytical methods include green building assessment tools and methods; Leadership in Energy and Environmental Design (LEED) rating system; economic analysis of green building alternatives; and evaluation for innovation and organizational change. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BC 5144:

Sustainable Infrastructure Systems

Relevant issues and state of the art technologies for sustainable civil infrastructure systems, including energy generation, water supply and treatment, wastewater systems, solid waste systems, and transportation/mobility systems. Analytical methods include development-scale sustainability assessment tools and methods; green materials performance assessment and evaluation; economic analysis of system alternatives; demand assessment/optimization; and conceptual design approaches for different system types. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BC 5154:

Modeling in Design and Construction

Concepts, theory, and practice of building information modeling during

design and construction. Building delivery and project management concepts in relation to building information modeling. Computer applications for visualization, modeling, simulation, scheduling, and estimating. Analyze models for critical analysis and problem solving in the design, planning, and management of a construction project. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s):
Corequisite(s):

BC 5264G:
Advanced Fundamentals of Construction Management
Practical construction methods within the built environment. Construction materials, document drawings, management activities, fundamentals of construction scheduling and planning. Quality, quantity, and cost of materials necessary to complete a construction project. Construction information technology tools. Pre: Graduate Standing.
Credit Hour(s): 6
Lecture Hour(s): 6
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BC 5314:
Applied Building Sciences
Fundamentals of building physics and other sciences dealing with the built environment, scientific means and methods for evaluating and simulating building performance in various contexts, emphasis is put on thermal, hygrothermal (moisture and mold), lighting, daylighting, acoustic performance - all performance topics are evaluated over the life cycle of a building and their impact on sustainability. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BC 5374:
Advanced Lifecyle BIM for Facility Management
BIM (Building Information Modeling) concepts and tools for identifying, capturing, analyzing, and delivering facility life cycle data. Data-centric and model-centric workflows for data handover. BIM models for a system-oriented model review and case study utilization. Advanced tools and programming language to search the BIM model. Workflow process. Apply case studies to assess MEP (Mechanical, Electrical, Plumbing) systems from a facility manager perspective. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BC 5514:
Principles and Practices of Construction I
Using a case study approach coupled with several term projects to achieve its objectives, this course covers the principles and practices of construction means and methods for CSI divisions 1-6 with emphasis on concrete, masonry, and steel construction. The course also integrates topics in project management, including project contract types and delivery methods, bonds and insurance, conceptual and detailed cost estimating methods, planning and scheduling techniques, and resource/cost scheduling. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BC 5524:
Principles and Practices of Construction II
Using a case study approach with various term projects, this course builds on concepts covered in BC 5514, focusing on the principles and practices of construction means and methods for CSI divisions 7-13. Emphasis is given to finishing works, thermal and moisture protection procedures, curtain wall construction, and special construction methods. The course integrates advanced topics in project management including schedule updating techniques, resource and cost tracking and control tools, and linear scheduling.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BC 5514 OR BC 55514 (UG)
Corequisite(s):

BC 5904:
Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

BC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BUSINESS ADMINISTRATION

Parviz Ghandforoush, Head

Professors: Sudip Bhattacharjee; Kevin Carlson; Dipankar Chakravarti; Parviz Ghandforoush; Tabitha James; Mahmood Khan; Sattar Mansi; Viswanath Venkatesh; Xin Wang;

Associate Professors: Wade Baker; William Becker; Donald Hatfield; Barbara Hoopes; Raymond Major;

Professor of Practice: David Simpson;

General Contact: mba@vt.edu

General Contact: msba-ba@vt.edu

General Contact: htmdpt@vt.edu

Graduate Programs: http://www.mba.vt.edu

Program Site: https://cba.pamplin.vt.edu/masters/admission.html

Program Site: http://www.htm.pamplin.vt.edu

The Pamplin College of Business offers graduate level programs in Blacksburg on the main campus, at the extended campus in Falls Church, VA, and online. The Master of Business Administration (MBA) degree program has two program formats (options): Evening (part- or full-time) based in Falls Church and Online with synchronous virtual classes each month. The plan of study leading to the Master of Business Administration degree is a 48-credit program requiring a Bachelor of Science or Bachelor of Arts degree from an accredited college or university. Faculty teaching in the Evening MBA program are members of the following departments in Pamplin: Accounting & Information Systems, Business Information Technology, Finance, Hospitality and Tourism Management, Management, and Marketing. The MBA degree program offered by the Pamplin College of Business is fully accredited by the Association to Advance Collegiate Schools of Business (AACSB International). The Master of Science in Business Administration (MSBA) with a concentration in Hospitality and Tourism Management is offered primarily at the Northern Virginia Center in Falls Church, VA but with availability via online capabilities on our Blacksburg campus. The Master of Science in Business Administration with a concentration in Business Analytics is offered at the Blacksburg campus.

SPECIAL FACILITIES

National Capital Region Virginia Tech in the greater Washington, D.C., metro area is dedicated to furthering the university's three missions – education, research, and outreach. With facilities, faculty, graduate degrees, and research in the region since 1969, Virginia Tech has a long tradition of creating new knowledge and applying it to the critical problems facing the Washington, D.C. area, the Commonwealth of Virginia, the nation, and the world. The Evening MBA in the NCR offers classes at the Falls Church location. MSBA-Hospitality and Tourism Management classes are also taught in the Falls Church location. Pamplin Hall The MSBA-Business Analytics courses are taught on the main campus in Blacksburg at Pamplin Hall.

Falls Church

The Graduate Programs offices are housed at the Northern Virginia Center in Falls Church at 7054 Haycock Road, just across from the West Falls Church metro station, and near Rt. 7, I-66 and I-495. The Evening MBA program holds classes at the Northern Virginia Center in Falls

Church. MSBA-Hospitality and Tourism Management classes are taught in the Falls Church location.

Pamplin Hall, Room 1030

Classes for the MSBA-Business Analytics degree are taught in Blacksburg in Pamplin Hall: https://vt.edu/about/locations/buildings/pamplin-hall.html

DEGREES OFFERED

MBA Degree

Offered In (Virtual, National Capital Region)

TOEFL

iBT: (90.0)

GRE

General: Verbal (154.0), Quantitative (154.0)

GMAT

: Total (600.0)

Two program options (formats) of EvMBA and OMBA. Completion of 48 credit hours of coursework, 3.0 undergraduate GPA, GMAT/GRE (EvMBA). Evening MBA - flexible part- or full-time program, classes in the evening, fall and spring start. Located in Falls Church, VA. https://mba.vt.edu/evening.htmlOnline MBA - cohort based, fully online, 50% synchronous with live class sessions each month, summer start only. https://mba.vt.edu/online.html

Degree Concentrations:

Available in the Evening MBA program

Business Intelligence/Analytics, Cybersecurity Management, Entrepreneurial Leadership, Financial Management, Global Business, Information Technology Management, Organizational Leadership, Dual degree option with Master of Information Technology degree, Dual degree option with Master of Science in Business Administration - Hospitality and Tourism Management degree.

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

iBT: (90.0)

MSBA-Business Analytics: The program requires the completion of 30-credit hours including a 15-hour business core and 15-hour analytics core, including two courses directly related to a corporate sponsored capstone project.cbia.pamplin.vt.edu MSBA-Hospitality and Tourism Management: The MS in Business Administration (MSBA) with a concentration in Hospitality and Tourism Management is located in the greater Washington, D.C. metro area, the nation's hub for hospitality business; it is offered exclusively at the Virginia Tech Northern Virginia Center in Falls Church, VA. The MSBA is a professional degree designed to either help students advance their professional career in HTM or as an important step to pursuing a Ph.D. and a subsequent academic career. https://htm.pamplin.vt.edu/graduate/msba.html

Degree Concentrations:

Business Analytics

The concentration in business analytics in the Master of Science in Business Administration (MSBA-BA) is designed to give students from multiple disciplines the necessary business knowledge, technical expertise, and professional skills to be effective business analytics practitioners. Admission to the program is competitive with selected based on leadership and communication skills, motivation and quantitative aptitude and computing experience. Undergraduate students who want to pursue an accelerated program or graduating students who are interested in pursuing a graduate degree may apply for the program. Students from all majors can apply. The application process includes the following: Online application via graduate school ($75 non-refundable fee) Application Deadline: November 1 (Late application will be processed as space allows) Transcripts GMAT or GRE scores (inquire about waivers) TOEFL or IELTS scores (for international students) Academic and Professional Goals Essay Resume with 3 references and contact information ~2 minute introductory video sharing how you heard of the MSBA-BA program and two things that differentiate you from other MSBA-BA applications (*A video produced via cell phone is sufficient) Applicant interview (qualified applicants will be contacted to schedule an interview after the online application has been reviewed) Cumulative minimum 3.0 GPA or better is desired The capstone project is the cornerstone activity of the Master of Science in Business Administration with a concentration in Business Analytics (MSBA-BA program). It is essential to the learning that takes place during the intensive year-long curriculum. Students work on interdisciplinary, four-to-five member teams on a corporate project that has significant strategic importance to corporations. At the end of the project, students will prepare a professional consulting report that summarizes and supports their findings and builds a business case for their recommendations. They will also make a formal presentation. Corporations provided data and a project coordinator. Students will gain experiential learning and apply classroom learning to real-world problems. This experience will not only enhance students' technical skills, but provided business acumen that facilitates execution of those skills.

BUSINESS, ACCOUNTING AND INFORMATION SYSTEMS

Robert Davidson, Head

Professors: Reza Barkhi; France Belanger; Sudip Bhattacharjee; Robert Davidson; Jennifer Joe; Ling Lisic; John Maher; Steven Sheetz; Linda Wallace;

Associate Professors: Andrew Acito; Jingjing Huang; Sarah Stein; Liang Tan; David Tegarden; Marshall Vance;

Assistant Professors: Matthew Cobabe; Matthew Erickson; Michelle Harding; Sean Hillison; Michelle Lowry; Kimberly Walker;

Visiting Faculty: Jeffrey Pittman;

R. B. Pamplin Professor: France Belanger;

KPMG Professor: Reza Barkhi;

Thomas M. Wells and Kathy Dargo Professors: Sudip Bhattacharjee; John Maher;

Wayne E. Leininger Professor: Ling Lisic;

Curling Visiting Professor: Jeffrey Pittman;

John E. Peterson Professor: Jennifer Joe;

Collegiate Assistant Professors: Cintia Easterwood; Dana Garner;

Professor of Practice: Donald Compton; Colleen Green; Nadia Rogers;

Associate Professor of Practice: Lynn Almond;

Assistant Professor of Practice: Gregory Kogan; Jean Lacoste; Eric Martin; Jason Sharp; Jacob Shortt;

General Contact: acis@vt.edu

Graduate Contact: jessicaf22@vt.edu

Graduate Site: http://graduateschool.vt.edu

Department Site: http://www.acis.pamplin.vt.edu

The Department of Accounting and Information Systems offers programs of graduate study leading to the degrees of Master of Accounting and Information Systems and Ph.D. in Business with concentration in Accounting and Information Systems.

SPECIAL FACILITIES

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Accounting and Information Systems

The Department of Accounting and Information Systems is located on the third floor of Pamplin Hall.

DEGREES OFFERED

MACIS Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

GMAT

: Waived

Master of Accounting and Information Systems Program The Master of Accounting and Information Systems Program (MACIS Program or Program) provides graduate level education for professional careers in accounting, assurance, business, and information systems auditing. It is especially appropriate for those individuals planning to become a CPA, CMA, or CISA and enter professional accounting. For those planning to enter a Ph.D. program, the Program offers the necessary foundation.The MACIS Program is open to students with a bachelor's degree in any discipline. For those who have fulfilled the background requirements, the Program consists of 30 semester hours and can normally be completed within one academic year. Students without prior collegiate studies in accounting, information systems, and/or business administration can expect to spend additional time in the Program completing prerequisites. The MACIS Program offers five Options designed to prepare students for different types of careers: Accounting Analytics, Audit, Tax, Financial Services and Information Systems. Accounting Analytics provides students with a degree grounded in applying state-of-the-art analytics concepts, techniques, and software to help solve accounting and assurance problems, as well as improving general business decisions. Audit prepares students to effectively practice as accountants or auditors within a company or public accounting firm, ranging from small firms or companies to large firms or Fortune 500 companies and other large entities. Tax prepares students to provide tax planning and consultation, as well as preparation services in the tax department of companies or large public accounting firms. It also prepares students to perform these services in smaller public accounting firms where they are likely to perform both audit and tax services. Financial Services provides students with an analytical perspective from which s/he can effectively examine key business decisions related to financial markets and institutions and advise clients accordingly. Finally, Information Systems prepares students to work within the Advisory Practice of a large professional services firm, become an information system auditor, or work in the information technology department within a company. Courses generally offered include: ACIS 5014 Information Systems Audit and Control ACIS 5104 Fundamentals of Accounting ACIS 5114G Advanced Financial Accounting ACIS 5124 Governmental and Nonprofit Accounting ACIS 5194 Financial Statement Analysis* ACIS 5214 Advanced Strategic Cost Management ACIS 5314 Tax Concepts and Research ACIS 5324 Taxation of Business Entities* ACIS 5334 Advanced Corporate Tax ACIS 5364 Multi-jurisdictional Tax Concepts ACIS 5414 Auditing Theory* ACIS 5424 Research and Analysis in Accounting* ACIS 5444 Forensic & Investigative Accounting ACIS 5504 Sys/Database Concepts ACIS 5524 Advanced Database Management Systems ACIS 5534 Information Systems Development ACIS 5584 Information Systems Security and Assurance ACIS 5624 Cybersecurity Governance and Risk Management ACIS 5654G Advanced Accounting Analytics* ACIS 5754 Accounting Internship BIT 5424 Advanced Business Info Viz/Analytics BIT 5534 Applied Business Analytics and Intel II FIN 4264 Managing Risk with Derivatives FIN 4274 Equity Securities FIN 5194 Commercial Law *Course required under all Options Deadlines:[RN1] Domestic International Fall July 1* April 1* Spring January 1 September 1 Summer May 1 January 1 * We strongly encourage applying by January 15 if seeking an assistantship and/or scholarship. If not seeking an assistantship and/or scholarship, we strongly encourage domestic applicants to apply by April 15 (international deadline is April 1 as indicated above).

PhD Degree

Offered In (Blacksburg)

GMAT

: Total (650.0)

TOEFL

Paper: (650.0)

iBT: (115.0)

The program leading to the Ph.D. in business with a concentration in accounting and information systems (ACIS) permits the student to pursue advanced graduate studies in preparation for a career in university teaching and research. The first two to three years of the Ph.D. program are devoted to course work. The program's basic requirements include core course work in accounting and research methods, as well as course work in a supporting area and statistics. The remainder of the time is devoted to the dissertation and development of coauthored research papers. There is no foreign language requirement, although computer proficiency is expected. The following specific courses are required in the major field: ACIS 5974, 6004, and two of the following: 6014, 6024, and 6504. Depending on a student's background and research method interest, additional ACIS courses will be required. Each candidate for the Ph.D. in business with a major in accounting and information systems must pass the first and second year research paper requirements, a written examination at or near the completion of course work, defend a dissertation proposal before the accounting and information systems faculty, and pass a final oral examination after the dissertation is completed.

GRADUATE COURSES (ACIS)

ACIS 5014:

Information Systems Audit and Control

This course explores the theories and practices of audit and control of computer-based information systems. Audit and control of information systems is examined from the viewpoint of management, systems professionals, and auditors. The rationale for controls, control theories, and audit practices are emphasized. Graduate Standing Required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 3504 (UG), ACIS 4414 (UG)

Corequisite(s):

ACIS 5044:

International Issues in Accounting

Accounting issues related to international business activities and foreign operations. Comparative effects of U.S. and international accounting standards on financial reporting and analysis of financial statements. Effects of multijurisdictional taxation on business structures and transactions and impacts of foreign currency translation on financial and commercial markets and related risks. Audit and governance standards in international business. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5104:

Fundamentals of Accounting

Fundamentals of accounting systems as they relate to decision making. Attention is directed toward accounting for the core of management control and financial reporting systems, and as integrally related to the information system. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5114G:

Advanced Financial Accounting

Detailed analysis of external financial reporting. Study of debt and equity investments, derivatives, and foreign currency. Proper application of Securities and Exchange Commission reporting regulations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5124:

Governmental and Nonprofit Accounting

An analysis of current governmental and nonprofit accounting, budgeting, reporting, and auditing concepts, models, and practices. Identification and evaluation of alternative concepts and models will also be emphasized. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5144:

Financial Statements for Managers

Use and analysis of financial accounting information. Business decisions based on advanced statistical analysis of financial data. Estimation of company value, past performance, and forecasted future performance.

Impact of operating, investing, and financing activities. Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5154:

Analyzing Financials and Implementing Controls

Financial statement analysis as an aid to decision making. Investing and lending decisions as they affect financial statement users of domestic, global, and entrepreneurial companies. Analysis and design of control systems to accomplish short-term objectives and enable management attention on long term strategic issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5104

Corequisite(s):

ACIS 5194:

Financial Statement Analysis

Detailed treatment of analyzing financial statements for making lending and equity investment decisions. In depth coverage of how to analyze a company's industry, competitive advantages, accounting quality, profitability, and risk. Introduction to forecasting financial statements and application of financial statement forecasting to equity valuation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5104

Corequisite(s):

ACIS 5294:

Management Control Systems

Analysis and design of control systems to facilitate short term decisions in order to allow management attention on long term strategic issues. Such systems integrate financial, marketing, production, and other business policies in accomplishing the goals and objectives of an organization. Accounting techniques are the core of management control systems, and information systems provide necessary links. Includes impact of tax planning, financial reporting, and internal and external auditing systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5104

Corequisite(s):

ACIS 5314:

Tax Concepts and Research

Tax research process including analysis of fundamental tax concepts underlying interpretation and application of tax law, mechanics of tax research, written and oral communication of research results, tax planning, and practice and procedure before tax authorities. The course explores the sources and hierarchy of tax law and the interaction of law and its interpretation and application to contemporary tax issues, as well as the recognition of the impact on and opportunities for future tax planning. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 3314 (UG)

Corequisite(s):

ACIS 5324:

Taxation of Business Entities

The tax aspects of forming and operating partnerships and corporations, and the sale and liquidation of a partnership interest. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 3314 (UG)

Corequisite(s):

ACIS 5334:

Advanced Corporate Tax

Covers the tax aspects of corporate redemptions, liquidations, and reorganization. The law of consolidated tax returns will also be covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5324

Corequisite(s):

ACIS 5364:

Multi-jurisdictional Tax Concepts

Tax issues of business enterprises operating in multiple taxing jurisdictions; multi-state and international taxation will be discussed. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5324

Corequisite(s):

ACIS 5414:

Advanced Financial Statement Auditing

In-depth exposure to auditing concepts, and applications. Study of financial statement business cycles. Study of the auditing environment as well as professional and regulatory standards for the profession. Examine the use of technology throughout the auditing process. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5424:

Research and Analysis in Accounting

Analysis and research of potential solutions to complex accounting and financial reporting problems. Problem-solving using professional accounting standards databases and academic accounting research. Verbal and written communication of research findings and recommendations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5444:

Forensic and Investigative Accounting

Forensic Accounting is a specialized area of accounting which uses accounting methods and financial techniques to assist in solving economic-based crimes. This course will provide students an opportunity to gain experiences in forensic accounting as well as commonly used computer forensic software and techniques. The focus is on litigation support, fraud risk management, fraud investigation, and the related audit tools. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 3115 (UG)

Corequisite(s):

ACIS 5504:

Information Systems Design and Database Concepts

This course is an introduction to design methodologies in information systems. Structured systems analysis and design methodologies are discussed. An introduction to database design methodologies is also included. Topics related to different database models and their implementation is discussed. Students are also required to design and implement information systems using appropriate computer software. Pre: MBA/MACCT standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5514:

Management of Information Systems

An analysis of theories and practices used in the management of systems that generate information and decisions to coordinate and control business operations. Both the viewpoints of the manager and the systems professional are covered in this course. Graduate Standing Required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5524:

Advanced Database Management Systems

This course relates database theories and practices to concepts from other areas, such as programming languages, algorithms, data structures, and information systems. The relational, network, and hierarchical models are introduced. A major portion of the course deals with data manipulation languages for the relational model, design theory for relational databases, and query optimization.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5504

Corequisite(s):

ACIS 5534:

Information Systems Analysis and Design

Modeling of semantically-driven information systems. Object-oriented (OO) requirements definition, analysis, modeling, and design. Application of unified modeling language (UML) techniques for development of OO designs of information systems in complex business situations. Development of use cases, activity diagrams, sequence and communication diagrams, class hierarchies, behavioral state machines, package diagrams, object persistence formats, navigation diagrams and deployment diagrams. Management of the systems development process, including the spiral construction and implementation phases of the process. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5574 (BIT 5574):

Healthcare Data Management

Organization and management of data in the health care industry. Includes standards for electronic health records, healthcare enterprise systems architecture, health database design, existing database platforms, data integration from multiple sources, and database accessibility. Analysis of health-care-related organizations from the perspective of multiple user groups including patients, technicians, nurses, physicians, clinics, hospitals, and insurance companies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BIT 5564

Corequisite(s):

ACIS 5584:

Info Sys Security & Assurance

An examination of the concepts, technologies, and applications of security in information systems. Topics include cryptography; security and threats to computers, e-mail systems, and internet networks; intrusion detection systems; and e-business security. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5604:

Accounting Fundamentals

An introduction for practicing executives to financial accounting cycles and transactions, financial statement reporting, and internal managerial accounting and costing. This course is designed to give executives an understanding of accounting systems, and to illustrate and highlight potential points at which the systems could be manipulated. Executive MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5614:

Implementing Management Controls

The management control process is designed to influence managers and other employees of an organization to implement the strategies of the organization. The activities of management control include: planning, coordinating, communicating, and evaluating. This course addresses the important role that accounting and other information play in this process. Executive MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5624:

Cybersecurity Governance and Risk Management

Cybersecurity governance and risk management programs in organizations. Governance frameworks for cybersecurity and external drivers for cybersecurity. Risk management, including existing frameworks, principles, and strategies related to risk assessment and implementation of cybersecurity policies, controls, and procedures. Budgeting and evaluation of risk management programs. Compliance with organizational cybersecurity programs, including risks of insider threats, management of security-related personnel, and establishment of cyber hygiene. Cybersecurity governance in relation to cybersecurity regulation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5654G:

Advanced Accounting Analytics

Design and development of accounting systems using relational database management tools. Extraction and analysis of accounting data using queries, analytics, and visualization techniques. Application of accounting data analytics concepts using commercially available tools such as audit management software and current visualization tools Proper preparation of data and use of analytics algorithms and visualization techniques to inform decision making. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5704:

Managing Information for Executive Decision Making

An overview of the theories, practices, and technologies used in the management of information systems for business decision making. Topics include use of information systems, electronic business, business intelligence tools and knowledge management, customer relationship management systems, data warehousing, virtual teams and organizations, and information security and privacy, and their role in improving organizational decision-making capabilities. Graduate standing in EMBA or PMBA program required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5754:

Internship in Accounting

Full time, supervised internship experience at a public accounting firm, private company or governmental or nonprofit entity to gain practical, professional experience. Focus on advanced accounting concepts, procedures, and problem-solving tools applied in real-world environment through both individual and group work. Reporting on insights obtained during internship experience.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5444 OR ACIS 5324 OR ACIS 5194

Corequisite(s):

ACIS 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5954:

Study Abroad

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ACIS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5994:

Research And Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ACIS 6004:

Accounting and Information Systems Research Methods

A doctoral level seminar emphasizing the understanding and application of research methods used in Accounting and Information Systems Research. Course activities concentrate on initiating doctoral students to the perspectives, methods, techniques, and skills necessary for conducting research in the Accounting and Information Systems disciplines. Topics covered include philosophy of science, the nature of theory, research methods, study design, and measurement. Students evaluate and present research from current journals, develop research proposals, and write a literature review for a topic of their choice. Doctoral standing is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 6014:

Behavioral Research in Accounting Seminar

A doctoral level seminar emphasizing the design and evaluation of research conducted in the behavioral research area of accounting. The primary emphasis is on behavioral decision theory and its applications to the accounting function. Primary seminar material is selected from recent journal articles and current working papers on relevant topics. Requires development and presentation of research proposal related to behavioral research in accounting.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 6004 (UG) OR ACIS 6004

Corequisite(s):

ACIS 6024:

Financial Capital Markets in Accounting Seminar

A doctoral level seminar emphasizing the design and evaluation of research conducted in the financial capital markets area of accounting. Concentrates on empirical markets-based research concepts and methodologies utilized in accounting. Primary seminar material is selected from recent journal articles and current working papers on relevant topics. Requires development and presentation of research proposal related to capital markets in accounting.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 6004 (UG) OR ACIS 6004

Corequisite(s):

ACIS 6044:

Seminar in Archival Audit Research

Review and critique of seminal journal articles and working papers that examine audit quality using archival research methods. Theoretical development of research questions on audit quality and application of rigorous research designs on the determinants and consequences of audit quality. Research inquiry and archival methods for audit quality. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ACIS 7994:

Research And Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BUSINESS, BUSINESS INFORMATION TECHNOLOGY

Quinton Nottingham, Head

Professors: Parviz Ghandforoush; Tabitha James; Paul Lowry; Anthony Vance; Viswanath Venkatesh; Alan Wang; Christopher Zobel;

Associate Professors: Alan Abrahams; Idris Adjerid; Quinton Nottingham; Onur Seref;

Assistant Professors: Mikhail Gordon; Alice Jang; Jiayi Liu; Vitali Mindel; Wenqi Shen;

R.B. Pamplin Professor: Christopher Zobel;

Eminent Scholar and the Suzanne Parker Thornhill Professor: Paul Lowry;

Eminent Scholar and Verizon Chair of Business Information Technology

Director Executive PhD: Viswanath Venkatesh;

General Contact: bit@vt.edu

Graduate Contact: sheasw@vt.edu

BIT Ph.D. Site: https://bit.vt.edu/academics/graduate-programs/phd-program.html

BIT department home page: https://bit.vt.edu/

The PhD in Business with a concentration in Business Information Technology is designed to be a full-time, four-to-five year, residential program offering specialized study in information systems and technology, business analytics, security, and operations and supply chain management. The program emphasizes the study of systems and technologies used in the creation, storage, exchange, analysis, and use of information in organizational decision making. Considerable emphasis is given to the use of statistics, data science, machine learning, experimentation, surveys, field studies, and theory building. Study of these topics requires that the student have a strong background in quantitative methods and computing, but also strong conceptual thinking, creativity, and writing skills. The primary objective of the program is to prepare graduate students for successful academic careers in tenure-track positions that value high-quality research and teaching. This objective is realized through a research-oriented program of study that provides extensive interaction with our faculty of outstanding researchers and teachers.

SPECIAL FACILITIES

The Department of Business Information Technology is located in Pamplin Hall with its main office in room 1007.

Data & Decision Sciences Building

Starting Fall 2023, the BIT PhD core faculty and all PhD students will move to the new state-of-the-art Data & Decision Sciences Building, a 100,000 square foot world-class facility for a truly outstanding educational and research experience.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

GRE

General: Verbal, Quantitative

GMAT

: Verbal, Quantitative

Responsibility for the administration of the PhD in Business with a concentration in Business Information Technology is shared by the Department of Business Information Technology, the Pamplin College of Business, and the Graduate School. General university graduate degree requirements, procedures, and policies, are available through the Graduate School's web site http://graduateschool.vt.edu/. Applicants to the PhD in Business with a concentration in Business Information Technology must complete and submit scores for the candidate’s choice of either the GRE exam or the GMAT exam. There is no minimum required GRE/GMAT score, but full GRE/GMAT exam results must be provided. However, entrance into this prestigious Ph.D program is highly competitive, and thus all other factors being equal, candidates should be in the upper 90th percentile or higher in these exams to be fully competitive. High grades from quality universities, academic references, and demonstrated potential for conducting academic research all weigh in heavily on admissions decisions. All Ph.D. candidates must complete a minimum of 90 semester hours beyond the baccalaureate. This total must include a minimum of 60 semester hours of approved course work and no fewer than 30 hours of research and dissertation credits. A prior master’s degree or work experience are not required, but the most competitive applicants usually have at least one of these factors; it is thus extremely rare that a student with only an undergraduate degree would be admitted. At least 50 percent of all graduate course credits (excluding research and dissertation credits) must be earned at Virginia Tech. The program of study must also satisfy the following departmental requirements: 1. BIT Ph.D. students are required to take approximately 30 hours of Ph.D. seminars hosted by the department. Moreover, students will select a flexible methodology track, generally in one of three areas for 15–18 credits: (1) behavioral and organizational information systems and operations management methods; (2) econometric and financial methods; or (3) operations research/management science methods. Moreover, there are a large number of Ph.D. seminar electives and method courses students can add for further expertise in artificial intelligence/machine learning, security, human-computer interaction, big data analytics, computer science, disaster resilience, management, marketing, operations research/IE, and other areas. 2. At least two continuous years must be spent in residence on the Blacksburg campus as a full-time student. A minimum of 24 graduate-level semester credit hours must be earned during this period. 3. The BIT department only admits Ph.D. students on a full-time basis. Admitted students are funded with a generous stipend of $34,000 plus additional summer support of $6,000 the first two years. Full tuition waivers and other benefits are given. In return, all students work 20 hours a week during Fall and Spring semester as graduate assistants to help with grading, research, and administrative duties. Additional summer funding is available starting in the third year on a competitive basis. As needed, additional funding is available for software, data collection, travel to conferences, and the like. We aim to fully fund BIT Ph.D. students for four years, subject to their adequate performance. Exceptional students who are on track for completion in their fourth year plus publication in elites are eligible for a fifth year of funding, which provides substantial advantages for job placement at top business schools. 4. Per graduate school policies, the BIT Ph.D. is a full-time residential program, and students are expected to be in residence the entire year (including most of the summer, with the exception of Graduate School allowed vacation/leave). During the first two summers students are required to complete a summer research paper, which is rigorously evaluated and represents the each student's screening exam for continuation in the program. 5. To prepare for academic employment, students will be asked to teach one carefully selected course later in their program (usually after third year), subject to departmental needs. 6. Each student's formal program of study is prepared during the second or third semester of study. This plan is developed by the student in conjunction with the Ph.D. advisory committee. Aside from finalizing the courses that a student will be contracted to complete for graduation, this is also when the student formally arranges for a Ph.D. advisor and Ph.D. committee. In formulating the program, attention is given to the student's prior academic preparation and career objectives. 7. There are multiple additional requirements such as completion of Pamplin College workshops in Ethical and Scholarly Research Practices, and Inclusion and Diversity, and participation in any department-hosted research series. Each student participates in and receives a formal annual evaluation to provide constructive feedback on their performance and details on any corrective action that is needed, if applicable. 8. Becoming a Ph.D. candidate is a formal process and designation, which requires that the student have successfully passed both of their summer papers, all of their coursework, and have a formal plan of study approved. Moreover, the final step in becoming a Ph.D. candidate will be to pass the formally scheduled "preliminary exam," which tests the candidate's knowledge of their research area and readiness to complete their dissertation, in terms of a formal dissertation proposal. Upon successful completion of the preliminary exam, the student is then cleared to use their remaining time in residence to complete their dissertation (during this time, coursework consists of pass/fail dissertation credits.

GRADUATE COURSES (BIT)

BIT 5114:

Crime and Conflict in Cyberspace

In-depth exploration of the cyber threat landscape and the motives, methods, and mechanisms that shape it. Complex and evolving nature of security, privacy, policies and safety in cyberspace. Consequences posed by cyber threats at the individual, corporate, national, and societal levels. Cyber threat research, governance and analysis. National and international policies and strategies for protecting cyberspace.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5124:

Cyberlaw and Policy for Information Technology

Key legal, ethical, and policy cyber governance and cyber security topics for managers and information security officers. Legal rights, remedies, and limitations related to cybercrime, computer intrusion, national security, and data breaches. Privacy laws and standards, impact assessments, privacy and security by design as policy and legal requirements. Comparison of international approaches to relevant laws and policies. Fundamentals of managing legal and policy aspects of information technology and security. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5134:

Cybersecurity Program Design and Operations

Development and maintenance of the enterprise cybersecurity life-cycle. Design of a comprehensive and resilient cybersecurity program in alignment with business objectives. Implementation and management of security operations. Security assessments and remediation of deficiencies. Security intelligence, analytics, and incident response. Measurement and communication of program effectiveness. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5324:

Predictive Analytics & Data Mining for Executives

Implementation of predictive analytics and data mining to support business decisions. Building analytics capability within an organization.

Data exploration, cleaning, and visualization. Use of a structured methodology for data mining practice. Supervised and unsupervised modeling techniques, and their applications. Translation of model outputs to business policies and practices. Pre: Graduate standing.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIT 5404:

Decision Modeling & Business Analytics

Business decision modeling, including descriptive, predictive and prescriptive analytics. Linear and integer programming, distribution and network modeling, waiting line analysis, non-linear modeling, and multi-criteria decision making. Simulation for extending decision modeling to scenarios involving uncertainty and risk. Software tools for problem analysis and solution. Translation of model outputs to business policies and practices. Illustrating applications in organizations of all types and in global environments. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIT 5414:

Operations Management in a Global Environment

Role of operations and supply chain management in modern organizations. Organizational value creation through product and process design and management, use of appropriate quality processes and metrics, location and layout of facilities, coordination of supply chain partners and processes, forecasting demand, managing inventory, and using systems and technology effectively, in production and service industries. Emphasis on global issues, quantitative techniques, and the use of technology. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIT 5424:

Bus Visualization Analytics

Principles and techniques for information visualization and reporting for business analytics. Covers principles of human perception and application of information visualization software for preparation, exploration, synthesis, interpretation, and presentation of business data to support decision making. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIT 5474:

Computer-based Decision Support Systems

This course explains the characteristics, use, and development of decision support systems (DSS) within the context of other business information systems. The process of designing and implementing decision support systems in business is discussed from both theoretical and practical standpoints. Students will learn various ways of measuring the success of DSS implementation as well as the difficulties associated with all such measures. Students will learn to use common software tools to develop a simple DSS and will learn to use the Internet as a decision making and productivity tool. Pre: Graduate student standing or instructors consent.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

BIT 5484:

Cognitive Computing for Smart Service Systems

Modeling and design of smart services and service systems. Application of deep question-answer processes in subject matter domains for cognitive assistants. Integration of cognitive assistants into smart service systems. Service journey customization through context-adaptive cognitive assistants. Application of state-of-the-art cognitive computing resources towards building and training a cognitive computing system in a subject domain.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BIT 5474
Corequisite(s):

BIT 5494:

International Operations and Information Technology

This course includes concepts and issues critical in the globalization of business operations and information technology. Topics covered include the organization of global operations, cultural and national comparisons, planning global operations, facilities location, product development, technology transfer, global communication links, transborder data flow, international information systems, and other emerging operations and information technology issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5524:

Introduction to Business Intelligence and Analytics

Overview of business intelligence and analytics technologies and their strategic use including defining/framing the business context for decisions, decision models, data issues, business intelligence, building analytics capability, cloud computing, making organizations smarter, and measuring the value of analytics. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5534:

Applied Business Intelligence and Analytics

Development of business intelligence and analytics solutions and applications to various types of decision- making problems. Analytics software and techniques. Data preparation, data exploration and visualization, predictive analytics techniques, text analytics, spatial analytics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BIT 5524

Corequisite(s):

BIT 5564:

Healthcare Information Technology

Use of information technology in the health care industry. Topics address electronic health records, patient informatics, evidence based medicine, electronic prescribing and telemedicine. The use of these technologies to improve patient health and medical systems operations. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 4515, CS 2604

Corequisite(s):

BIT 5574 (ACIS 5574):

Healthcare Data Management

Organization and management of data in the health care industry. Includes standards for electronic health records, healthcare enterprise systems architecture, health database design, existing database platforms, data integration from multiple sources, and database accessibility. Analysis of health-care-related organizations from the perspective of multiple user groups including patients, technicians, nurses, physicians, clinics, hospitals, and insurance companies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BIT 5564

Corequisite(s):

BIT 5594:

Web-Based Applications and Electronic Commerce

An examination of the concepts, technology, and applications of electronic commerce in business and society. Topics include the world wide web as a platform for electronic commerce; intranets; electronic data interchange; electronic banking and payment systems; implementing security technologies and policies, security and firewalls; software agents; and social, legal, corporate governance and international issues of electronic commerce.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ACIS 5514 (UG) OR BIT 5474 (UG)) OR (ACIS 5514 OR BIT 5474)

Corequisite(s):

BIT 5604:

Modeling Decision Making for Competitive Advantage

This course examines a number of topics in management science and their applications in dealing with managerial problem solving. Decision theory and optimization techniques such as decision-trees, linear programming, integer programming, networks and others are studied, modeled and solved from a managerial and applied perspective. Business and industry cases are used to demonstrate usefulness and effectiveness of the models constructed. Students use software to perform computational studies, obtain solutions, and analyze the results for problems and cases. Graduate standing required. Executive MBA and Professional MBA Students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5624:

Program Management and Project Leadership

This course introduces the fundamentals of program and project management, beginning with project definition and culminating in the post-project review. Students will learn techniques, terms, and guidelines that are used to manage cost, schedules, risk, group dynamics, and technical aspects throughout the life cycle of a project.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5644:

Management of Information for Business Decisions

This course illustrates a variety of statistical methods to collect and analyze data sets. Complex problems, both business and societal, are studied and analyzed for trends, patterns, relationships and other useful information. Statistical tools such as probability distributions, sampling, hypothesis testing, regression and times series analysis, simulation, and forecasting are studied from a practical and business perspective. Business and industry cases are used to demonstrate the usefulness and effectiveness of the techniques used. Students use software to perform computational studies, obtain solutions, and analyze the results. Pre: Graduate standing in Executive MBA or Professional MBA program.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5654:

Project Management

This course introduces the fundamentals of project management, beginning with project definition and culminating in the post-project review. Students will learn techniques, terms, and guidelines that are used to manage cost, schedules, risk, group dynamics, and technical aspects throughout the life cycle of a project. Graduate standing required; Executive or Professional MBA students only

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5664:

Managing the Global Supply Chain

This course provides the student with expertise in the planning and control of business processes within a firm and across its global supply chain. Emphasis is placed on applying IT and process analysis skills to improving the quality and productivity of business firms and their supply chain partners. Efficient methods for streamlining the flow of information, services and products across functions, enterprises, and global boundaries are studied. Issues in designing and managing a network of suppliers in a global environment are discussed. Pre: Graduate standing in Executive MBA or Professional MBA program.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5724:

Managerial Statistics

Introduction to basic statistical (inference) tools necessary in managerial decision-making. Topics include, but are not limited to, descriptive statistics, elementary probability theory, sampling and sampling distributions, portfolio management, hypothesis testing, regression analysis, quality improvement, and Six Sigma concepts and methodology. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

BIT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BIT 6314:

Artificial Intelligence/Machine Learning/Deep Learning Bus Research Seminar

Builds foundational knowledge of artificial intelligence, machine learning, and deep learning (AI/ML/DL). Focuses on studying the use of AI/ML/DL to solve business problems and improve organizations. Emphasizes behavioral, organizational, and ethical issues related to the use of AI/ML/DL in business research and practice. Examines how employees work and collaborate with AI/ML/DL, how people interact with AI/ML/DL, and contextual applications of AI/ML/DL such as security and privacy, healthcare, social media, and the consumer experience. Discusses the approaches for and implications of using AI/ML/DL as a method in business research. Apply AI/ML/DL knowledge and skills to develop research articles for business journals. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 6324:

Design Science Seminar

Conceptual framework and research guidelines for analyzing and evaluating design science research. Selective, intensive coverage of topics related to creating and testing new and innovative information technology artifacts within the broader disciplines of information systems and operations management. Specific focus on research opportunities offered by social media analytics in design science research. Practical application of methods and techniques involving social media analytics in design science studies. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 6334:

Operations Management Seminar

Principles for analyzing and evaluating quantitative approaches to enterprise resource management (materials, labor, capacities, capital and information), in public, private, for-profit, and non-profit organizations. Production, Finance, human resources, and all forms of operations management. Advanced mathematical modeling of decisions for design, planning, and control. Analysis of research papers that involve theoretical development or rigorous application to the topics addressed in the course. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 6344:

Decision Analytics Seminar

Advanced study of analytic modeling techniques in support of decision making in a business context. Development and application of analytics to research problems in business management, transportation retailing, entertainment, government services, health care, and personal decisions. Emphasis on state-of-the-art approaches for descriptive, predictive, and prescriptive modeling. Evaluation of research papers that illustrate rigorous application and analysis of the topics covered in the course. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 6414:

Seminar in Information Technology

Advanced study of selected current topics in information technology emphasizing professional journal articles. Student research should lead to publishable paper. Course may be taken multiple times. Pre: restricted to graduate students in the Department of Business Information Technology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 6424:

Theory Building Seminar in Business Information Technology

Foundation and skills of theory building, conceptual development, and theory-inspired design. Focuses on information systems, operations management, organizational security, and technology-related management and organizational decision-making. Emphasizes modeling and development of theoretical contributions. Learn to write and review high-quality journal articles in business information technology disciplines grounded in theory. May be repeated 2 times with different content for a maximum of 9 credit hours. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

BIT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BUSINESS, EXECUTIVE BUSINESS RESEARCH

Viswanath Venkatesh, Program Director

Professors: Rajesh Bagchi; Reza Barkhi; Sudip Bhattacharjee; David Brinberg; Kevin Carlson; Dipankar Chakravarti; John Easterwood; Roger Edelen; Devi Gnyawali; Paul Herr; Jingjing Huang; Tabitha James; Juncai Jiang; Gregory Kadlec; Raman Kumar; Ling Lisic; Paul Lowry; Roop Mahajan; John Maher; Frank

May; Nancy McGehee; Juan Nicolau Gonzalbez; Mario Pandelaere; Richard Perdue; Cliff Ragsdale; Roberta Russell; Vijay Singal; Manisha Singal; Viswanath Venkatesh; Alan Wang; Richard Wokutch; Zheng Xiang; Christopher Zobel;

Associate Professors: Alan Abrahams; Idris Adjerid; Daniel Beal; William Becker; Robert Davidson; Jason Deane; Donald Hatfield; Richard Hunt; Eojina Kim; Onur Seref; Sarah Stein; David Townsend; Anna Ward Bartlett; Jin Xu; Ryan Zimmerman;

Assistant Professors: Kiran Awate; Shreyans Goenka; Sean Hillison; Pankaj Kumar; Shilpa Madan; Bradley Paye; Phillip Thompson; Broderick Turner; Marshall Vance; Pengfei Ye;

Adjunct Faculty: Mohammad Jahan-Parvar; Wei Liu; Adam Yonce;

Collegiate Professors: Michelle Seref;

Associate Professor of Practice: Kimberly Carlson;

Collegiate Assistant Professors: Joseph Simpson;

General Contact: execphd@vt.edu

Graduate Site: https://execphd.vt.edu/

Launched in 2016, the Executive Ph.D. in Business serves experienced executives who seek the advanced knowledge and skills needed to conduct high quality research on critical issues facing the business community. This part-time program challenges students to dive deeply into the scholarly literature and master advanced research methods in their chosen business discipline. Students blend this scholarly knowledge with their business experience to create novel insights embodied in a dissertation that addresses a complex business problem. Importantly, students develop the skills needed to publish their research in leading-edge research journals. Students who graduate from this program can pursue careers either in research-oriented business schools or in government or businesses. Prospective students should plan a four to five-year commitment to build the credentials needed to earn this unique and rigorous Ph.D. degree. The academic demands in this unique part-time program are on par with that of Pamplin's full-time Ph.D. program in Business.

SPECIAL FACILITIES

7054 Haycock RoadFalls Church, VA 22043

Northern Virginia Center

The Executive Ph.D. in Business is offered at Virginia Tech's Northern Virginia Center. The center, which opened in 1997, is the university's primary teaching location for graduate programs in the National Capital Region. The 232,000-square-foot facility is located in the heart of Northern Virginia - just off Route 7 and I-66, adjacent to the West Falls Church Metro and next to George Mason High School.

DEGREES OFFERED

PhD Degree

Offered In (National Capital Region)

Credit Requirements: The Virginia Tech Ph.D. in Business requires a minimum of 90 credit hours. The pro-gram for the Executive Ph.D. in Business assumes prior graduate study in business or a related field from which a maximum of 30 relevant credits can be transferred to meet core credit require-ments. Candidates without this preparation must complete an additional 30 credits of prepara-tory work. The remainder (a minimum of 60 credits) will include at least 30 credits of graded coursework (disciplinary/interdisciplinary and methodology seminars) and a minimum of thirty research/dissertation credits. Graded Coursework: The graded coursework is tailored to the student's primary disciplinary interest (corresponding to the six traditional concentrations offered at the Pamplin School: Accounting and Information Systems, Business Information Technology, Finance, Hospitality & Tourism, Management and Market-ing). The first two disciplinary content seminars parallel those taken by traditional full-time Ph.D. students. The remaining (two or more) content seminars provide additional disciplinary depth or interdisciplinary content tuned to the student's research interests. These disciplinary seminars typically meet on weekday evenings or Friday afternoons. The meth-odology seminars typically meet on weekday evenings or Saturday morn-ings or afternoons. These meeting times (outside of normal work hours) allow Executive Ph.D. students to participate synchronously with traditional Ph.D. students in live discussion (either face-to-face or via Zoom technology). Students will have access to faculty/tutors in all methodology courses to support their academic work. The microeconomics review and the business pedagogy course meet during the winter terms of the first and second year, respectively. The module on scholarly ethics, diversity and inclusion is completed during the Spring term of the first year. The fall and spring terms during years 1 and 2 use a hybrid delivery format. Classes meet each week, with every other week being a residential session usually held at Virginia Tech's extended campus in Northern Virginia. Typically, three of these residential sessions meet in Blacksburg. These mandatory residential sessions help the Executive Ph.D. student assimilate into the Pamplin community and facilitate face-to-face interactions with faculty, potential research mentors, student peers, and academic tutors who support coursework. During Year 1, students should plan on attending approximately 23 residential sessions (Fall: 8; Winter: 2, Spring: 8, Summer: 5). In Year 2, there are 18 residencies (no summer residencies). In Year 3, when students are working on their dissertation proposals there are only four residencies (Fall: 2 and Spring: 2). No formal residencies are planned thereafter. However, students are always welcome and encouraged to attend in-person activities. During this period, students are strongly encouraged to communicate regularly and substantively with their Ph.D. Dissertation Committees. The study plan for the program lays out the registration schedule for the research and dissertation (R&D) credits. In Year 1, students register for 3 R&D credits (the summer proposal). In Year 2, students register for 7 R&D credits to initiate work on research papers as well as their dissertation proposal. Students in Year 3 register for 20 R&D credits during which they work on their dissertation proposal (and defense). Thereafter, as they work on their dissertations, students register for only 3 R&D credits in each of the Fall and Spring semesters. A minimum of 30 R&D credits must be accumulated during the program. Note that in Year 3, each student has an opportunity to obtain teaching experience. This may involve teaching an online or face-to-face graduate or undergraduate class in Pamplin. This experience is essential for gaining the pedagogical skills integral to a Ph.D. degree. Research: The emphasis on the creation and publication of high-quality scholarly research in the Executive Ph.D. in Business mirrors the heavy emphasis on research in our full-time Ph.D. programs. The program also stresses participation in research conferences as part of the student mentoring and career development process. Even as the disciplinary and methods seminars focus on the research literature, the following activities create an early and sustained emphasis on first-hand student involvement in the scholarly research process: YEAR ONE Each student must write a research proposal/ paper by the end of the first summer. Along with the disciplinary content seminar assignments, this paper aims to stimulate and test students' ability to blend their formal academic training and business experience to develop a research proposal that addresses an important business problem. This proposal serves as the student's qualifying examination and is evaluated by a three-member reading committee who provide feedback similar to a journal review. YEAR TWO In addition to the stipulated coursework, students work with their faculty advisory committee to develop the above proposal (or one or more other promising ideas) into a paper(s) for presentation at a research conference and/or submission for publication review to a quality journal. Often, this proposal is developed further as a basis for the student's dissertation research. By the end of the summer term of their second year, students are expected to progress to the point where they can identify likely future mentors and form a Ph.D. Advisory Committee. YEAR THREE Students work closely with their Ph.D. Advisory Committee to develop the dissertation proposal. Students are expected to defend their respective dissertation proposals by the end of the summer of their third year in the program. The proposal defense meets the Graduate School's requirement for student's preliminary examination. Students who successfully defend their dissertation proposal move to complete their dissertation research under the guidance of their Ph.D. Dissertation Committee. YEAR FOUR (AND BEYOND) Students work closely with their Ph.D. Dissertation Committee to complete the dissertation research. The dissertation is defended orally in a final examination and the written dissertation document is filed with the Graduate School once the student has met the expectations of the Ph.D. Dissertation Committee. Regular and substantive communications with the committee (particularly the chair/co-chairs) is critical to timely completion of the dissertation. The dissertation defense meets the student's final examination requirement for the VT Graduate School.

BUSINESS, FINANCE

Vijay Singal, Head

Professors: Gregory Kadlec; Arthur Keown; Raman Kumar; Sattar Mansi; George Morgan; Vijay Singal;

Associate Professors: Randall Billingsley; John Easterwood; Roger Edelen; Jin Xu;

Assistant Professors: Tyler Beason; Luis Felipe Cabezon Otero; Andrew MacKinlay; Bradley Paye; Yessenia Tellez Parrales; Ngoc Tran; Pengfei Ye;

R. B. Pamplin Professor of Finance: Gregory Kadlec;

R.V & A.F Oliver Professor of Investment Management: Raman Kumar;

Wells Fargo Professorship in Financial Risk Management: Sattar Mansi;

SunTrust Professor of Finance: George Morgan;

J. Gray Ferguson Professor of Finance: Vijay Singal;

R.B. Pamplin Professor of Finance: Arthur Keown;

General Contact: fin@vt.edu

Graduate Contact: xujin@vt.edu

Graduate Site: https://finance.pamplin.vt.edu/graduate.html

Graduate School: http://graduateschool.vt.edu/

The Department of Finance, Insurance and Business Law offers graduate studies leading to two advanced degrees: the Ph.D. and M.S. in Business (with specialization in Finance). The M.S. is a 30-hour non-thesis program designed for a limited number of highly qualified students who wish to undertake specialized training in finance. However, students are not always admitted to the M.S. program.The PhD program requires dissertation on an approved topic in finance and is designed to prepare students for academic careers in research-oriented schools of business. Accordingly, the program's primary focus is on research. Over the first two years in the program students develop their conceptual and empirical tool kits by taking a series of graduate level courses in Economics, Statistics, Econometrics and four semesters of doctoral seminars in Finance. Students are also required to write research papers after their first and second year in the program, in addition to the dissertation. They are also provided the opportunity to teach at least two courses during the program. Thus the program aims to prepare them for the research and teaching missions of their academic career. As a small program with typical enrollment of two or three a year, the students get plenty of personal attention from our department faculty which is nationally recognized for its contribution to research. More information may be found on the Finance webpage at https://finance.pamplin.vt.edu/graduate.html.

SPECIAL FACILITIES

The Department of Finance, Insurance, and Business Law is located at Virginia Tech's Blacksburg Campus with a main department office in 1016 Pamplin Hall.

Office Hours

The Department of Finance office is open 8:00am to 5:00pm ET, Monday through Friday.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)

GMAT

GRE

The M.S. is a 30-hour non-thesis program designed for a limited number of highly qualified students who wish to undertake specialized training in finance. However, students are not always admitted to the M.S. program.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)
GMAT

: Total (600.0)
GRE

Students admitted into the program typically have a master's degree, competitive GMAT scores, strong transcripts and letters of recommendation. Financial aid is provided for four years conditional on satisfactory academic progress. Additionally, the department provides a "Professional Development Fund" to each student to help defray costs of conference travel, journal submission fees, etc. Fifth year funding is available based on a case by case basis. During the first two years students are required to take about 40 hours of course work including nine 3-credit courses in microeconomics, macroeconomics, statistics and econometrics, and four 3-credit doctoral seminars in finance --- two each in Corporate Finance and Investments. Additionally, the students sign up for at least 50 hours of Research and Dissertation credits over the four years, adding up to at least 90 credit hours required to graduate from the doctoral program. In addition to the course work the students are required to successfully present their first and second year research papers to the faculty to better prepare them for their upcoming dissertation. The submission and presentation of the second year paper is one of two key events in the program. The other key event is the dissertation defense.

GRADUATE COURSES (FIN)

FIN 5024:

Principles of Finance

Explores the basic concepts underlying the finance function, relevant to finance and non-finance majors. It provides an understanding of the firms decision-making framework in the context of the economic environment (financial markets) in which the decisions are made. The specific topics covered, at a basic level, include investment decision under uncertainty, valuation, risk and return, market efficiency, portfolio theory, asset pricing, cost of capital, capital investment decisions, and futures and options markets.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BIT 5724, FIN 5084, ACIS 5104

Corequisite(s):

FIN 5084:

Analytical Framework for Business Managers

The course provides and analytical coverage of the concepts and principles that affect and govern a firms relationships and interactions with its customers, suppliers (of goods, materials, services, and funds), competitors, employees, other organizations and the regulatory environment. The course is designed specifically for first semester MBA students and the coverage is from the perspective of a business manager. Topics covered include demand and supply analysis, individual choice, pricing strategies, market structure, monetary policy, and government regulation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIN 5104:

Corporate Finance

Provides a broad coverage of the major policy making areas of a corporation. The course covers topics in capital investment policy, financing and capital structure policies, dividend policy, financial statement analysis, financial forecasting, and the basics of working capital management.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5024

Corequisite(s):

FIN 5114:

Interest Rates and Fixed Income Securities

Analysis of the macroeconomic environment of interest rate determination and monetary policy. Description and analysis of several classes of fixed income securities. Measurement and management of interest rate risk. Introduction to arbitrage-free term structure modeling and applications to the pricing and hedging of debt securities.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5024

Corequisite(s):

FIN 5124:

Investment Analysis and Portfolio Management

Examines the role and functioning of securities markets. Specific topics include the equity market, fixed-income securities market, and mutual funds. The course presents portfolio and capital market theory, the efficient markets hypothesis, institutional organization, and security valuation techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5024

Corequisite(s):

FIN 5174:

Corporate Financial Risk Management

Derivative securities such as options, futures, forwards and swaps, and their payoffs and profits. Use of binomial and Black-Scholes models for pricing options. Relationship between spot and forward prices. Use of real options in capital budgeting. Identification of domestic and global risk management problems of corporations. Application of derivative contracts to manage corporate risk.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5024

Corequisite(s):

FIN 5184:

Currencies and Global Finance

Explores the international economic environment, including analyses of exchange rates, international monetary systems, contemporary currency regimes, and current financial crises. Examines a firms exposure to various kinds of exchange risks and the methods and financial instruments used to manage those risks. Introduces global opportunities open to firms for raising capital, foreign investment in financial assets, and managing currency and interest rate risk.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5024

Corequisite(s):

FIN 5194:

Commercial Law and Professional Liability

Study of the Uniform Commercial Code, including negotiable instruments, sale of goods, secured transactions and documents of title. Debtor-creditor relations, special topics in business organization law, and the law of professional liability. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 3055 (UG) OR FIN 3054 (UG) OR FIN 3074 (UG)

Corequisite(s):

FIN 5604:

Financial and Economic Environment of Business

Provide an understanding of the principles that affect a firms interactions with its customers, suppliers, competitors, employees, and other organizations, and the roles of monetary and fiscal policies in the overall economic environment. Study the basic principles and concepts underlying the finance function. Topics covered include demand and supply analysis, individual choice, pricing strategies, market structure, monetary and fiscal policies, and the role of the Federal Reserve in managing growth, employment, and inflation. Graduate standing required. Executive MBA and Professional MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIN 5614:

Financial Modeling and Corporate Finance

Provides coverage of the major financial decisions facing a corporate manager in a modeling framework. The specific topics covered are analysis of financial statements, financial planning, cost of capital and capital budgeting, capital structure, working capital management, dividend policy, and international financial management. Executive MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIN 5654:

Principles of Financial Management

Provide an understanding of the basic principles and concepts underlying the finance function, and the analytical tools for making financial decisions. The specific topics covered are Goals of a Corporate Firm and Agency Problem, Cash Flow Estimation and Financial Statement Analysis, Financial Assets and Markets, Time Value of Money, Risk and Return, Diversification and Capital Asset Pricing Model, Valuation of Stocks and Bonds, and Market Efficiency. Executive MBA and Professional MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5604

Corequisite(s):

FIN 5664:

Corporate Finance

Explores value creation through capital investment and capital structure choices. Provides an understanding of the impact of capital investment and capital structure policies on the value of a corporation. Includes a theoretical component and a strong applied component with cases and projects. Executive MBA and Professional MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5654

Corequisite(s):

FIN 5674:

Investments and Portfolio Management

Risk, return and portfolio theory, knowledge of equity and debt markets, derivatives, and management of investment portfolios. Introduction to equity and bond valuation, mutual funds, portfolio analysis, market efficiency, options, and futures. Executive MBA and Professional MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5654

Corequisite(s):

FIN 5734:

Legal and Ethical Issues in Innovation and Technology

Intensive exploration of legal and ethical issues that affect the operation of business in the high technology, networked, environment. Studies public and private regulation of business, emphasizing innovation and the networked environment. Explores the interrelationship of ethics and law, the duties of directors and managers, and decision-making under uncertain regulatory parameters, especially in evolving businesses. Included within these areas are: participating in the regulatory process, intellectual property, ethical frameworks, privacy and security, and international perspectives. Pre: Graduate standing required. Professional MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIN 5744:

Current Topics in Corporate Governance

Current issues and trends in corporate governance. Topics include overview of the corporation, stakeholder versus shareholder, board of directors, executive compensation, ownership structure, committee assignments, regulatory and legal environment, and firm performance. Graduate standing in the Professional MBA program required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIN 5784:

Global Finance

International economic environment, currency regimes, and currency crises; analysis of foreign exchange rates. Firms exposure to exchange risk and methods for managing risk including competitive and transaction exposure. Global opportunities to raise capital and foreign investment vehicles. Professional MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 5654

Corequisite(s):

FIN 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIN 5954:

Study Abroad

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FIN 5964:
Field Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FIN 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

FIN 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FIN 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

FIN 6004:
Doctoral Development for Business and Finance
Examines the basic principles of finance theory. The course covers the theories of choice under certainty and uncertainty. The criteria for choice under uncertainty are used to develop asset valuation models and theoretical frameworks for the firms capital investment, capital structure, and dividend decisions. The course also deals with the basics of information theory and the theory of efficient capital markets. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECON 5005
Corequisite(s):

FIN 6104:
Financial Research Methods
Integration of econometric methodology (including regression) and inference with research in finance, financial accounting and other quantitative business research issues/areas. Introduction to the data used in financial research. Discussion of research papers which incorporate rigorous applications of the topics covered in the course. Topics covered include event studies, estimation of systematic risk (beta) of stocks, cross-section of expected stock returns, and common econometric problems such as heteroscedasticity, autocorrelation and multicollinearity in business settings and their resolution. Pre: Graduate Standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FIN 6115:
Corporate Finance
Analysis of financial decisions in the corporate firm under uncertainty and in the presence of agency costs, information asymmetries, incomplete markets, and taxation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): FIN 6004
Corequisite(s):

FIN 6116:
Corporate Finance
Analysis of financial decisions in the corporate firm under uncertainty and in the presence of agency costs, information asymmetries, incomplete markets, and taxation.
Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 6004

Corequisite(s):

FIN 6125:

Investments

Advanced treatment of equity, debt, and speculative markets. Topics include security return distributions, market efficiency, mean-variance portfolio theory, capital asset pricing, arbitrage pricing, option pricing models, and futures markets. Theory and empirical evidence are examined.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 6004

Corequisite(s):

FIN 6126:

Investments

Advanced treatment of equity, debt, and speculative markets. Topics include security return distributions, market efficiency, mean-variance portfolio theory, capital asset pricing, arbitrage pricing, option pricing models, and futures markets. Theory and empirical evidence are examined.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 6004

Corequisite(s):

FIN 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIN 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BUSINESS, HOSPITALITY AND TOURISM MANAGEMENT

Zheng Xiang, Head

Professors: Mahmood Khan; Nancy McGehee; Juan Nicolau Gonzalbez;

Associate Professors: Kristin Lamoureux; Manisha Singal; Zheng Xiang;

Assistant Professors: Eojina Kim; Florian Zach;

J.Willard and Alice S. Marriott Professor of Revenue Management: Juan Nicolau Gonzalbez;

Graduate Contact: jnicolau@vt.edu

Graduate Contact: ggorey@vt.edu

General Contact: htmdpt@vt.edu

Graduate Contact: mahmood@vt.edu

Graduate Contact: maryrichards@vt.edu

HTM Departmental Website: https://htm.pamplin.vt.edu/graduate.html

The Virginia Tech Hospitality and Tourism Management (HTM) graduate programs are consistent with the mission of a comprehensive research university; our program emphasizes developing student ability to generate new knowledge through research and to apply that knowledge to the challenges and problems of hospitality and tourism businesses. HTM is one of six departments in the Pamplin College of Business. Our vision, which permeates throughout our graduate program, is to build on a legacy of teaching and research excellence and to create global leaders in the business of hospitality and tourism management. We offer two graduate degrees: Masters of Science in Business Administration (MSBA) with a concentration in Hospitality and Tourism Management, and a Ph.D. in Business with a Concentration in Hospitality and Tourism Management. The MSBA is offered primarily at our National Capital Region Campus in Falls Church Virginia but with availability via online capabilities on our Blacksburg campus. Three graduate certificates are also available at our National Capital Region Campus in revenue management and data analytics, international strategy, and entrepreneurship. For more information, go to the certificate tab in the graduate catalog. The Ph.D. is offered exclusively at the Virginia Tech campus in Blacksburg. Our graduate program is widely recognized as one of the premier programs of its kind in the world. Graduates are prepared for challenging Hospitality and Tourism Management careers in academic and/or industry positions. Two principles permeate our graduate programs. First, our graduate programs focus on the application of theories and methodologies from a variety of disciplines to the critical challenges and problems of hospitality and tourism management businesses; the department provides extensive opportunities for graduate students to partner with faculty to conduct research on significant industry problems. Second, the program is customized to the student's interests; degree candidates and their advisory committees plan individual graduate programs pursuant to the student's career goals and degree requirements. For MSBA graduate students, the program provides an opportunity for growth as a student and as a career-directed individual. The goal is to provide advanced knowledge and tools to middle management personnel, consultants and researchers in the hospitality and tourism industry. This goal is accomplished by providing a stimulating environment that encourages seeking knowledge and applying it to the needs of the industry. Fulfillment of the goal occurs as a result of considerable interface and focus, in the classroom and out, with industry and educational leaders on issues of immediate and long-term importance to the industry. The degree includes opportunities in three primary areas of specialization: revenue management and data analytics, international strategy, and entrepreneurship. At the Ph.D. level, the program emphasizes the research applications of business concepts and strategies to hospitality and tourism management. The goal of the Ph.D. program is to develop the next generation of faculty for Hospitality and Tourism Management Business programs at major research universities throughout the world. We accomplish this goal by producing doctoral graduates who have both conceptual and methodological knowledge and significant research experience in the applications of that knowledge during their Ph.D. program. Students develop the knowledge, skills and research abilities to become successful scholars by engaging in close and collegial research collaborations with a faculty comprised of internationally renowned scholars, journal editors, and professional leaders.

SPECIAL FACILITIES

Our graduate programs are offered on two campuses. The Masters of Science in Business Administration and the associated Certificate Programs are offered primarily at our National Capital Region Campus in Falls Church Virginia but with availability via online capabilities on our Blacksburg campus. As a professional degree, this location in the nation's leading hospitality hub provides easy access to many of the world's major hospitality corporations. The Ph.D. in Business is offered exclusively on the main Virginia Tech campus in Blacksburg, providing easy access to our research library, research and statistical support systems, and our research community of leading scholars both in the Pamplin College of Business and in other departments and colleges across campus. On the Blacksburg campus, the Department of Hospitality and Tourism Management occupies the third floor of Wallace Hall. The Ph.D. student facilities include private carrels and a dedicated computer lab with access to a full range of office, graphical, scientific, and statistical software. All Ph.D. classes are taught in a dedicated classroom with comprehensive technological equipment and software. The Department partners with the Inn at Virginia Tech, the Virginia Tech Dining Service, and the local and regional hospitality and tourism industry to provide research and internship opportunities.

University Research Facilities

Virginia Tech is a comprehensive research university with world class technology, computing, and library resources.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

GMAT

GRE

General: Verbal, Quantitative, Analytical

TOEFL

Paper: (577.0)

iBT: (90.0)

Virginia Tech's Hospitality and Tourism Management Ph.D. in Business emphasizes the research applications of business concepts and strategies to hospitality and tourism management. The goal of our program is to develop the next generation of faculty for Hospitality and Tourism Management Business programs at major research universities throughout the world. We accomplish this goal by producing doctoral graduates who have both conceptual and methodological knowledge and significant research experience in the applications of that knowledge during their Ph.D. program. Students develop the knowledge, skills and research abilities to become successful scholars by engaging in close and collegial research collaborations with a faculty comprised of internationally renowned scholars, journal editors, and professional leaders. More specifically, our curriculum emphasizes (1) the understanding of business theories and practices in hospitality and tourism management and (2) the conceptual skills and understanding of research design, measurement, and statistical analyses necessary to be effective and productive researchers. The faculty has developed the doctoral program to provide challenging research and learning experiences for students seeking the skills to become leading researchers. The key ingredients to the program's success are excellent students, a dynamic, research-oriented faculty who publish regularly in top-tier journals, and research collaboration between students and faculty. The specific curriculum and research program is customized to the individual student's interests; each student works with an advisory committee to develop a program of study and a research dissertation focusing on her / his specific areas of interest. Degree Requirements (66 Credits plus the MS or MBA) Core Requirements (15 credits / 12 graded credits, see note 1) * HTM 5944 Graduate Seminar (taken each semester in residence with 3 credits toward the degree) * 12 credits of coursework in research methodology, ethics, and data analysis taken at the Ph.D. level at Virginia Tech HTM Requirements (6 credits / 6 graded credits) * HTM 6434: Theory Development for Hospitality & Service Management (3 credits) * HTM 6464: Research Foundations in Hospitality and Tourism Management (3 credits) Specialization/Major Area (15 credits / at least 9 credits must be graded) * At least 3 credits need to be at the HTM 6000 level * Remaining credits (12) can be either within or outside HTM, and can be at the 5000 or 6000 level. * Students are encouraged to include at least one section of HTM 6974 Independent Study, whereby the finished product is a manuscript to be submitted to a top-tier academic research journal. Students are also encouraged to take GRAD 5114, Contemporary Pedagogy, if they and their committee feel this would assist them with improving their teaching skills. Dissertation (30 credits) Total Credits – 66 Credits Notes:

1) Depending on the student's specific research interests, the Pamplin College of Business offers a series of behavioral, financial, data analytic, and econometric methodology courses. Additionally, students may substitute other Ph.D. level methodology courses from elsewhere at Virginia Tech. All substitutions must be approved by the student's primary advisor and the HTM Department Head. 2) A minimum of 9 credits of coursework are required each semester of the first two years of the program. Students receiving either GTA or GRA support are required to take 12 credits of coursework each semester they are funded. 3) Courses should be taken in consultation with the committee and approval of the Head of the Department. 4) Courses cannot be counted twice under any of the above mentioned categories.

5) No more than 9 hours can be taken as independent study courses.

6) Consult graduate catalog for the number of courses that can be transferred. Ph.D. Degree Progression and Requirements Advisory Committee Students selected for admission to the Ph.D. program are

accepted by a faculty member who will be their major professor. This selection is based primarily on the potential of a match between the professor's expertise and the student's interest as expressed on the application for the program. An Advisory Committee consisting of the major professor and at least three other members will be recommended by the student and his / her major professor to the Department Head to be recommended to the Graduate School. This committee advises the student in planning a program of study and in other degree requirements. It also serves as the examining committee for the preliminary and final examinations. A typical committee consists of a minimum of three faculty (including the major professor/chair) from the Department of Hospitality and Tourism Management. It is expected, but not required that the committee include at least one faculty member from outside the Department reflecting the student's cognate area. Preference is given to on-campus faculty. The makeup of the advisory committee may be different for the preliminary exams and the dissertation. The student should consult with his/her major professor in determining the makeup of the advisory committee. Additional information about the advisory committee can be found in the Graduate School catalog. Program of Study A Program of Study refers to the plan of course work and any other related experiences that prepare the student for successful completion of the preliminary exams and dissertation defense. A program of study meeting all department requirements should be submitted to the Graduate School prior to completing the third semester in residence beyond the Masters degree at this University. The program of study must be approved and endorsed by the student's advisory committee, the Department Head, and the Graduate School. Qualifying Exam The HTM Qualifying Exam for first year Ph.D. students is comprised of a research project completed during the spring and summer of their first year. Research Proposal: During the spring semester, students will work with their primary advisor to develop and submit to the HTM Graduate Coordinator by April 1 a five to ten page research proposal that includes: Applied and theoretical justification for the research study (including the study's managerial contribution and theoretical foundations which are supported by a summary of the literature) The specific research questions, problem, and/or hypotheses Research methodology A detailed timeline for the research project As this work will commonly extend beyond the end of the summer, the proposal should include a statement articulating the deliverables which will be provided by September 1 as part of the preliminary research report The contribution of the proposed research to the student's Ph.D. program of study Anticipated target journal Prior to submission, this proposal must be approved by the student's committee chair. Preliminary Research Report (due September 1) With the guidance of their Ph.D. committee chair, students will develop and submit to the HTM Graduate Coordinator a report of work completed during the summer. This report should coincide with the approved list of deliverables provided in the proposal. Deviations from the approved list of deliverables would be considered only as a rare exception and must be explained and justified. Prior to submission, this report will be approved by the student's committee chair. Final Research Report Draft Manuscript (due by December 31) Under the guidance of their Ph.D. committee chair, students will develop and submit to the HTM Graduate Coordinator a final research report draft manuscript being prepared for journal submission, reporting on the approved summer research project. While it is anticipated that this report may not yet be completed, it should include, at a minimum, a well-articulated introduction, a substantive review of the literature, a detailed description of the research methodology, and preliminary results. Prior to submission, this report must be approved by the student's committee chair. During the fall semester, students will be required to present the research to HTM 5944 Graduate Seminar. Preliminary Examination This examination is designed to determine the candidate's ability to progress into the dissertation phase. The written portion of the examination is to be completed within 6 months of completion of coursework. The oral examination phase requires that an examination card be obtained. The graduate student is responsible for the completion and submission of all paperwork required from the Graduate School at least two weeks in advance of the exam date.   The examination is given in two parts: 1. Written Examination 2. Oral Examination – scheduled within 30 days of successful completion of the written examination. Student Qualification Requirements Students sitting for all preliminary exam components, i.e. written and oral examination parts, must have completed the following; 1. Approval of the Student's Chair and Committee members 2. They must have fulfilled all requirements for taking their preliminary examination as stipulated by the Graduate School (see Graduate Catalog). 3. They must have an approved plan of study on file with the Graduate School.   Written Preliminary Examination - Specialization (Major) Area The preliminary exam, oral and/or written, is conducted by the student's advisory committee. It is comprehensive in nature and is intended to test a student's ability to integrate, synthesize, and apply concepts, facts, and techniques in solving new and complex problems associated with hospitality and tourism management. The student may be tested on any aspect of their plan of study. It is recommended that the student meet with his/her advisory committee prior to preparing for the exam to discuss the nature of the exam, the format, and the evaluation procedures that is the best fit.   Dissertation Candidates for the Ph.D. are required to carry out original research which will add to the present body of knowledge in the field of hospitality and tourism management. Students are required to defend their proposal for their dissertation research to their dissertation committee. Prior to this defense they must present their proposal in the HTM 5944 Graduate Seminar. The purpose of this exercise is to provide students with the opportunity to get feedback from peers and faculty before actually defending the proposal to his/her committee. Guidelines for this seminar are available in the HTM Department. The department supports both traditional and article-style formats for dissertations. See departmental policy for process.   Final Examination This oral examination is primarily a defense of the dissertation, although the examining committee may test the candidate on any material relevant to the field of study. The examination is scheduled through the Graduate School in the same manner as the written preliminary examination. A final presentation of the dissertation in Graduate Seminar is also required. Graduate School requirements must be met for submission of dissertation. Refer to the Virginia Tech Graduate School Policies and Procedures for further information.

MS Degree

Offered In (National Capital Region)

The MS in Business Administration (MSBA) with a concentration in Hospitality and Tourism Management is in the Washington DC metro area, the nations' hub for hospitality business; it is offered exclusively at the Virginia Tech National Capital Region Campus in Falls Church VA. The MSBA is a professional degree designed to either help students advance their professional career in HTM or as an important step to pursuing a Ph.D. and a subsequent academic career. The MSBA focuses on three areas: Hospitality and Tourism Business Analytics and Revenue Management, International Hospitality and Tourism Strategy, and Entrepreneurship in Hospitality and Tourism Management. The MSBA program is designed to allow students to pursue specializations in each of these focal areas. Many of the MSBA courses are taught by industry professionals with a strong focus on professional practice and case studies. The student's plan of study is designed and approved in conjunction with a graduate advisory committee comprised of a chair and a minimum of two graduate faculty members. On admission into the graduate program, an initial advisor is assigned by the Graduate Program Director. The student can change this advisor after s/he has the opportunity to better know the faculty and articulate her/his interests. The following reflects the general framework of the MSBA plans of study. Master of Science in Business Administration: Hospitality and Tourism Management I. Business Core Course: (15 hours of coursework) BIT 5724 Managerial Statistics ACIS 5104 Fundamentals of Accounting FIN 5024 Principles of Finance MGT 5314 Dynamics of Organization Behavior MKTG 5104 Marketing Policy and Strategy II. HTM Concentration: (15 Hours of coursework selected from the following areas.) HTM courses should constitute at least 50% (three courses) of the concentration hours. Students are encouraged to complete at least one of the specializations. Students may opt to take additional hours to complete all three specializations, or they can take additional hours to complete complimentary graduate certifications. For more information, go to the Certificates section of the Graduate catalog. Hospitality and Tourism Business Analytics and Revenue Management Specialization Offered during the Summer, 9 hours (100% online) Required: HTM 5564 Information Technology and Business Analytics in Hospitality and Tourism Management HTM 5574 Revenue Management for Hospitality Services Choose a third course from either MGT or BIT : MGT 5804 Strategic Leadership in Technology-based Organizations BIT 5594 Web Applications and E-Commerce International Hospitality and Tourism Strategy Specialization Offered during the Fall semester, 9 hours Required: HTM 5534 Strategic Management and Competitive Strategy in the Hospitality Industry HTM 5024 International Service Management Choose a third course from the following: MGT 5784 International Management MGT 5794 Strategic Management MKTG 5704 International Marketing Strategy Entrepreneurship in Hospitality and Tourism Management Specialization Offered during the Spring semester, 9 hours Required: MGT 5814 Entrepreneurial Leadership Choose two courses from the following: HTM 5424 Human Resource Management HTM 5464 Franchising in Hospitality Management HTM 5444 Financial Management in the Hospitality Service Industries TOTAL HOURS REQUIRED FOR M.S.B.A. DEGREE: 30 HOURS Time to completion: 12-15 months

GRADUATE COURSES (HTM)

HTM 5024:

International Service Management

Overview of the contemporary issues in the international business environment facing multinational service firms in the hospitality industry. These issues include such topics as: global strategy formulation, and implementation; technology challenges; diversity in customers and employees; political and legal concerns; and effective organizational structures for long term survival.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5424:

Human Resource Management

This course focuses upon the attainment and retainment of employees within the hospitality industry. Topics include the processes, practices and legal considerations involved in the employment of people in hospitality organizations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MGT 3334

Corequisite(s):

HTM 5444:

Financial Management in the Hospitality Service Industries

Fundamentals of financial management as applied to hotel, restaurants, institutions and similar service organizations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIN 3104

Corequisite(s):

HTM 5454:

Hospitality and Tourism Marketing Strategy and Policy

Examination of the role of marketing within the strategic planning of hospitality service organizations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 3104

Corequisite(s):

HTM 5464:

Franchising in Hospitality Management

Role of franchising in hospitality management. Contemporary issues related to franchising in different segments of hospitality industry, including franchise concept development, franchisor-franchisee relationship, franchise agreements, operational problems, and international franchising.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5514:

Contemporary Problems in the Hospitality Industry

Consideration and analysis of relevant industry problems and issues facing management personnel in the hospitality industries. Computer literacy required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5534:

Strategic Management and Competitive Strategy in the Hospitality Industries

To enable students to develop a comprehensive understanding of the concepts of strategic management and competitive strategy as applied to the hospitality industries.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HTM 4534

Corequisite(s):

HTM 5554:

Qualitative Research Methods in Business

This course focuses on the key components of qualitative methodology for research applications in business. The course introduces students to the basics of qualitative research in the business context as well as the ontological and epistemological foundations of qualitative research. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5564:

Information Technology and Business Analytics in Hospitality and Tourism

Theoretical foundation of IT applications in hospitality and tourism. Widely used information systems in operation, management, and e-business in HTM. Web marketing and distribution practices. Emerging analytics tools for business intelligence and strategic decision making. Impacts of IT on organizations and the industry as a whole. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5574:

Revenue Management for Hospitality Services

Dynamic forecasting of supply and demand, customer relationship management, services production, pricing, promotion, and distribution. Implications for human resources and information systems management. Application and integration of revenue and customer centric management theory. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5614:

Current Issues in Travel and Tourism Management

Current issues in the management of travel and tourism services. Environmental trends, planning and development, policy formulation, social and economic impact, and marketing of travel and tourism.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HTM 5944:

Graduate Seminar

Presentation and critical discussion of current literature and major topics in hospitality and tourism management. The seminar provides a forum for the discussion of research and research problems in hospitality and tourism management and the presentation of research by graduate students. Provides students an opportunity to prepare and present current work related to their thesis and dissertation activities. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

HTM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HTM 6414:

The Concept of Service in the Hospitality Service Industries

Seminar in the concept of service and its management.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HTM 5514

Corequisite(s):

HTM 6424:

Human Resources Management in the Service Industry

Examination of research and writings in the area of human resources management in service industries. Issues and opportunities in human resources management distinctive to hospitality service organizations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HTM 5424 OR MGT 5704

Corequisite(s):

HTM 6434:

Theory Development for Hospitality and Service Management

Seminar in theory construction in the areas of hospitality, tourism and service. Emphasis on the identification of relevant interdisciplinary paradigms and theory and the evaluation of social science research. Six graduate credits of hospitality and tourism courses required. Alternate years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 6444:

Advanced Quantitative Methods for Hospitality Applications

Methodologies and techniques for analysis, reporting, and critiquing hospitality issues using advanced concepts and quantitative methods in the scientific investigation of problems related to hospitality.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 6634

Corequisite(s):

HTM 6454:

Hospitality Marketing Research Problems

Research designs and methodologies for the solution of hospitality industry marketing problems. Analysis and interpretation of marketing research studies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HTM 5454, STAT 5634

Corequisite(s):

HTM 6464:

Research Foundations in Hospitality and Tourism Management

Advanced survey of classical and current literature in hospitality and tourism management. Tools to assess research questions, opportunities, and limitations of the research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HTM 5544

Corequisite(s):

HTM 6524:

Seminar in Tourism Management Research

Intensive exposure to conceptual and methodological areas of research in tourism management. Design and implementation of original tourism research. Examines key areas of tourism management research, including impact monitoring and measurement, destination development and management, forms of tourism activity, destination competitiveness and sustainability, tourism information systems and the tourist experience and behavior. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 6974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

HTM 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HTM 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BUSINESS, MANAGEMENT

Devi Gnyawali, Head
Ronnie Poff, Associate Head

Emeriti Faculty: Larry Alexander; Thirwall Bonham; Anthony Cobb; Larry French; James Lang; Robert Madigan; Steven Markham; Kent Murrmann; Jerald Robinson; Jon Shepard; Linda Tegarden; Richard Wokutch;

Professors: Kevin Carlson; Cynthia Devers; Devi Gnyawali; Christopher Porter;

Associate Professors: Jeffrey Arthur; Daniel Beal; William Becker; Donald Hatfield; Richard Hunt; Pankaj Kumar; Karen Schnatterly; David Townsend; Anna Ward Bartlett;

Assistant Professors: Kiran Awate; James Lewis; Maximilian Stallkamp; Phillip Thompson;

Visiting Faculty: Beverly Tyler;

Associate Professor of Practice: Lori Anderson; Dirk Buengel; Elizabeth Jamison; Zdenka Mena; Ronnie Poff; David Williamson;

Assistant Professor of Practice: Denise Cordova; Margaret Deck; Pakanat Kiratikosolrak; William Schaudt;

Collegiate Associate Professors: Christopher Courtney; Joseph Simpson; Chien-Chi Tseng;

R.B. Pamplin Professor: Cynthia Devers; Devi Gnyawali;

Adjunct Faculty: Charity Boyette; Richard Curtis; Tammy Kemp; Laura Raschke; Joseph Roark; Koehler Slagel;

Strickler Professor: Christopher Porter;

Graduate Program Coordinator: mkara@vt.edu

Graduate Program Director: rickhunt@vt.edu

Graduate Site: https://management.pamplin.vt.edu/Academics/phd.html

The Ph.D. program in Business Administration with a major in Management in the Pamplin College of Business is dedicated to preparing the next generation of research faculty at top academic institutions. The faculty of the Department of Management, who are highly respected both nationally and internationally, are committed to Ph.D. mentoring. That commitment is shown in a vibrant curriculum and an apprenticeship style that provides students opportunities to work closely with faculty. Our recent revision in the Ph.D. program has placed further emphasis on developing students' research skills and enabling students to develop papers for top-tier journals so that they are better prepared for faculty careers at research universities. Our approach to doctoral education is unique. We emphasize the preparation of students in ways that allow them to understand and address the whole organization from the study of individuals and groups within organizations to how they operate strategically in the larger business environment. Our program allows students to develop the knowledge and skills necessary to address the critical and complex questions faced by organizations today: those that require expertise that cuts across the boundaries of current organizational research disciplines. One of the core strengths of our program is the possibility for students to integrate micro and macro research literatures to examine phenomena of research interest. Our curriculum emphasizes a solid foundation in strategic management, organization theory, organizational behavior, human resources management, and ethics and social responsibility. Students first develop a firm understanding of management broadly and then specialize in any of these areas based on their research interests and collaborations with faculty. In addition, students acquire and develop skills in research design, measurement, and statistical analysis that will allow them to be effective, independent researchers for their academic careers. Our doctoral students engage in close and collegial research collaboration with our faculty who are highly respected nationally and internationally based on their research excellence. These student-faculty research collaborations continue years after the students graduate from our program. Our faculty has a strong commitment to teaching and Ph.D. mentoring. That commitment is shown in a vibrant curriculum and steady increases in the productivity of our graduate students. We view a doctoral education as the foundation for lifelong learning. We develop excellence in our students so that they can make significant scholarly contributions throughout their careers.

SPECIAL FACILITIES

Department of Management

Department of Management, 2007 Pamplin Hall (0233), 880 West Campus Drive, Blacksburg, VA 24061

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

MGT TOEFL: Paper (550.0), Computer-based (233.0), Internet-based test: at least 80, with no section sub-score less than 16 (80.0)

iBT: (80.0)

IELTS: Students taking the IELTS must obtain a score of at least 6.5, with no subscore below 6.5 to be considered for admission to Virginia Tech. (6.5)

The overall goal of the Ph.D. Program in Business Administration with Concentration in Management (Management Ph.D. Program) is to develop students into future academics who are capable of conducting high quality research and publishing in top management journals. It is a full-time, residential, four-year program offered in the main campus Blacksburg. Students in their first two years take seminars that begin by helping them understand the core theories in management and develop basic research skills. Subsequent courses specialize in either macro areas (strategic management, entrepreneurship, and innovation) or micro areas (organizational behavior and human resources), as well as advanced topics in research methods and statistics. Students in their 3rd and 4th years spend most of their time working on dissertation research and developing research papers for submission to management journals. Students must also teach at least one course while in the Ph.D. program. We seek applicants who have the motivation for high quality research and desire a career at a research university. Our program is designed to provide rigorous training in theory and methods and the opportunity to work closely with nationally and internationally renowned researchers so that our graduates have the skills necessary to succeed in their academic career. The following broad criteria are considered in evaluating applicants for admission to the Ph.D. Program in Management: Motivation and ability to conduct high-quality research that will allow placement at a top research university upon completion of their PhD; intellectual curiosity; ability to read, write, and speak English at a very high level; prior knowledge of business, research methods, and statistics. GMAT (we also consider GRE) scores are required to be considered for admission. New students are admitted to the program only in the fall semester.

GRADUATE COURSES (MGT)

MGT 5124:

Business Research Methods

Foundations of research methodology in business. Integrates research design, basic measurement and data analytic skills. Develops an understanding of quasi-experimental designs as a foundation for higher coursework in research design, measurement, and statistical analysis for business research. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5314:

Dynamics of Organization Behavior

This course examines the determinants and consequences of human behavior in formal organizations. The specific graduate focus is on understanding the individual, interpersonal, and group processes which underlie all human dynamics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5324:

Interpersonal Leadership for Managers

Develop a better understanding of leadership and the processes that underlie leadership effectiveness in complex organizational settings. Emphasis on utilizing and developing a personal approach to leadership. Interpersonal skills and communication; influence; leadership styles; leading teams; critical thinking skills; conflict management; crucial conversations; and empowering creativity.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MGT 5314

Corequisite(s):

MGT 5384:

Ethical Dimensions of Leadership

This course examines conduct in business within the context of moral philosophy. Emphasis is placed on the relevance of philosophical theories of morality to leadership and decision making in organizations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5424:

Business Negotiation: Strategies, Tactics and Skills

Examines negotiating as a process where two or more parties seek to build upon their common interests and manage their divergent ones. Both the context of negotiations and the skills of the parties in rational analysis and interpersonal relationships determine whether an agreement can be reached and the quality of the outcomes for the participants. Extensive use is made of simulated negotiation exercises followed by analysis of outcomes to enable students to practice applying concepts and theories developed by economists and social psychologists to concrete business cases. Pre-requisite: Graduate standing in the MBA program

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5594:

Technology and Innovation Management

This course takes a general managers perspective to examine the challenges of managing technology and innovation and their impacts on organizations. It provides students with a solid understanding of key concepts, tools, and frameworks useful in managing technology and innovation. Cases will also be used as a device for developing analytical and decision-making skills and for highlighting the reality of organizational and environmental complexities in managing technology and innovation. Pre-requisite: Enrollment in the Exec. or Prof. MBA program.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5604:

Team Building

An introduction to teams in management including the justification for team formation. Practical considerations for developing teams to improve personal and organizational effectiveness are covered,

particularly in organizations where significant diversity is present. Executive MBA students only.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5614:

Designing & Managing Orgs

This course focuses on the implications of globalization and the resulting cross-cultural relationships for leaders and managers of business organizations. The ways in which culture affects characteristics of individuals, interpersonal relationships, negotiation styles, and leadership practices are examined. Cases and exercises develop skills in applying theories and concepts to concrete situation. Executive MBA students only.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5634:

Strategic Business Environment

Course focuses on tools and techniques for industry and competitive analysis and describes methods used by organizations to develop and sustain a competitive advantage. Examples and cases from current business, single- and multi-business corporations in a variety of industries will be studied. Executive or Professional MBA program required.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5654:

Strategic Human Resource Management

Examines current issues critical to the management of an organizations human capital assets. Critically examines how systems of human resource policies and practices can be used to enhance a firms competitive strategy and achieve competitive advantage in the marketplace. Examines development and deployment of systems of human resource practices appropriate to specific organizational objectives and their impact on organizational effectiveness. Pre-requisite: Enrollment in the Professional MBA or the Executive MBA program.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5664:

Ethical Leadership in a Global Context

This course examines significant issues in business ethics and the forms they take in different cultures. A stakeholder approach is adopted and attention is focused on firms relationships with four important stakeholders: employees, consumers, governments, and communities. Skills at stakeholder analyses are developed through the application of various ethical theories to case studies of problems encountered in different cultures. Creativity in resolving conflicts among stakeholders with different values and interests is fostered through participation in experiential negotiation exercises. Graduate standing required. Executive MBA and Professional MBA students only.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5674:

Leadership for Change Management

Study methods for changing organizations and individuals within those organizations using organizational transformation techniques, information technologies, and different leadership/personality styles. Executive MBA students only.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5684:

Global Management and Strategy

Management challenges associated with global competition and the ways in which firms can create and sustain superior returns be

formulating and implementing effective strategies. Develops an integrated, multi-functional, general management perspective of the organization. Comprehensive case studies of large firms will be used to develop students skills in strategic thinking, analysis, and execution. Strong emphasis is placed on the global environment. Pre-requisite: Enrollment in the Executive MBA program.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5744:
Topics in Corporate Governance
Current issues and trends in corporate governance. Topics include overview of the corporation, stakeholder versus shareholder, board of directors, executive compensation, ownership structure, committee assignments, regulatory and legal environment, and firm performance. Graduate standing in the Professional MBA program required.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5784:
International Management
This course focuses on the management challenges associated with the development of strategies and the management of organizations in business enterprises whose operations stretch across national boundaries. It will provide students with the knowledge, skills, and sensitivities that will help them manage more effectively in an international environment.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MGT 5314
Corequisite(s):

MGT 5794:
Strategic Management
Examines business policy through a study of general managements task of strategy formulation and implementation. Comprehensive case studies concerning a variety of organizations serve as a basis for analysis. Pre: Final term M.B.A. standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5804:
Strategic Leadership in Technology-based Organizations
This course focuses on the role of the leader in crafting corporate and business strategies where technology provides the basis for the firms competitive advantage.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5814:
Entrepreneurial Leadership
Concepts and techniques for providing leadership in the entrepreneurial venture. Provides the theoretical understanding of the entrepreneurial process in the economy as well as the practical leadership, marketing, financial and production considerations for entrepreneurial initiatives for new ventures and established firms.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MGT 5824:
Technology-based Entrepreneurship
Entrepreneurship in technology-based startups, corporate, and public-sector organizations operating in digital environments. Experiential activities in commercialization and resource mobilization strategies. Design and validation of digital business models for launching technology-based ventures. Assessment and pursuit of entrepreneurial opportunities in cybersecurity, automation, artificial intelligence, and machine learning. Master of Information Technology (MIT) students only.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MGT 5804 OR ECE 5484

Corequisite(s):

MGT 5844:

Business & Corporate Strategy

Focus on strategic decisions of the firm and use of tools and techniques for external and internal analysis to develop and sustain a competitive advantage. Examples and cases of single and multi-business corporations in a variety of industries, both domestic and international. Prerequisite: Enrollment in Executive MBA program.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5854:

Ethics and Leadership in a Global Environment

Ethical issues in business and management using both a theoretical and a case study approach. Relevance of philosophical theories of morality and alternative views of corporate social responsibility to leadership and decision making in organizations. Pre: Graduate Standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5864:

Creativity & Design Thinking for Executives

Application of creative and design-thinking processes to generate novel solutions to complex social and economic problems. Deep user understanding, iterative experimentation, and opportunity identification as a way to enhance value creation for customers across the technology adoption lifecycle in corporate, academic, public, and non-profit organizations. Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5905:

Business Analytics Capstone

Management and execution of business analytics projects. Problem and scope definition, identifying objectives, data requirements and preparation, selection of software tools, project planning and administration, leadership and team building, and assessment of project value and effectiveness. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5906:

Business Analytics Capstone

Management and execution of business analytics projects. Integrated application of analytics knowlege, techniques, and tools resultinig in the development and delivery of insights, recommendations, and expected outcomes to corporate stakeholders in professional communications, presentations, and reports. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MGT 5905

Corequisite(s):

MGT 5954:

Study Abroad

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

MGT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MGT 6024:

Foundations of Management Theory

Theory development in management research. Theoretical models and perspectives as an intellectual foundation for management research. Individual-, team-, and firm-level management theories applied to the evaluation, testing, and advancement of management research. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 6224:

Applied Measurement in Business Research

Design and analysis of measures for use in business research. Measurement validity and reliability concepts to contexts such as personnel selection, market research, and employee/customer attitudes. Selective, intensive discussion of measurement topics in business research, including observed vs. unobserved variables in measurement; biases stemming from the use of particular methods; exploratory vs. confirmatory approaches to measurement; appropriate application of control variables.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MGT 5124

Corequisite(s):

MGT 6704:

Strategic Management and Organiation Theory Seminar

Current and classical theories in strategic management and organization theory will be examined. Students will identify and assess basic assumptions, fundamental research questions and opportunities, and limitations of these theories.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 6714:

Organizational Behavior Theory Seminar

Foundational and contemporary paradigms and theories supporting organizational behavior and research are examined. How these paradigms and theories shape, constrain, and foster the development of research is explored. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 6734:

Review of Research in Organizational Behavior & Human Resources Management

Current research in organizational behavior and human resource management will be examined. Students will assess fundamental research questions, opportunities, and limitations of this research. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 6744:

Management Research Practicum

Review of the scholarly research process and standards for top-tier journals. Writing and revising research papers using the standards. Development of research questions and theory, match of theory and research design, data analysis and presentation of results, articulation of contributions, and revision of manuscripts. Critique research papers and practice writing reviews. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 6944:

Graduate Seminar in Management Research

Presentation and critical discussion of current literature and major topics in management research. The seminar provides a forum for the discussion of research and research problems in management and the presentation of research by graduate students. Provides students an opportunity to prepare and present current work related to their dissertation, and to engage in other activities related to the promotion of their professional development. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MGT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

BUSINESS, MARKETING

Rajesh Bagchi, Head

Professors: Rajesh Bagchi; David Brinberg; Dipankar Chakravarti; Paul Herr;

Associate Professors: Frank May; Mario Pandelaere;

Assistant Professors: Shreyans Goenka; Broderick Turner; Yan Xu;

Kathleen Grega Digges Professor of Marketing:

VA-Carolinas Professor in Purchasing Mgmt. Professor of Marketing:

Mary F. McVay & Theodore R. Rosenberg Junior Faculty Fellow:

Robert H. Digges Professor of Entrepreneurial Studies:

R.B. Pamplin Chair of Marketing:

Graduate Contact: scrocket@vt.edu

Graduate Site: https://marketing.pamplin.vt.edu

Doctoral Program in Marketing: https://marketing.pamplin.vt.edu/prospective-students/prospective-phd.html

The Department of Marketing participates in the Pamplin College of Business MBA programs and offers two focused programs – an M.S. in Business with Concentration in Marketing focused on marketing research and Ph.D. in Business with Concentration in Marketing focused on basic research in marketing. The program is highly selective, rigorous, and personalized. The size of the program is strictly controlled to allow for intensive faculty-student collaboration. The required coursework provides rigorous exposure to the academic research literature in marketing as well as research methods and statistics. At the same time, we recognize that students bring a variety of interests and we will work with students to develop programs of study that will allow them to productively pursue those interests. The department will commit up to four years of financial assistance to students enrolled in the Doctoral Program in Marketing, assuming satisfactory academic progress is being made. Additional financial support may be available through summer teaching. For students interested in careers in marketing management, information is available on the Marketing website: www.marketing.pamplin.vt.edu. For students interested in the MBA program, information is available at http://www.mba.vt.edu.

SPECIAL FACILITIES

Behavioral Research Laboratory--The Department of Marketing manages the College's behavioral research laboratory. The lab maintains computer stations, some isolated, for data collection. Group tasks and interviews can be accommodated. Graduate students in Marketing have access to the lab facilities.

Department of Marketing

Department of Marketing- 880 West Campus Drive, 2016 Pamplin Hall (0236), Blacksburg, VA 24061

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

iBT: (100.0)

GRE

General: Verbal (159.0), Quantitative (164.0), Analytical (4.5)

GMAT

: Verbal (38.0), Quantitative (50.0), Analytical Writing Assessment (5.5), Total (690.0)

M.S. Overview The Marketing Department offers a Master of Science in Business with Concentration in Marketing focused on advanced marketing research. The program serves students who wish to pursue a Ph.D. but who have completed only an undergraduate degree. The program involves a high level of interaction with members of the marketing faculty. The M.S. program provides a point of entry for students with limited backgrounds, allowing them to gain insight on the training and career expectations for Ph.D.'s in marketing and to complete work preparatory to Ph.D. study in core areas like mathematics, statistics, and research methods. Prospective applicants should understand that this program is not a substitute for the M.B.A. for students seeking a professional business degree, given its function as a gateway to the Ph.D. program. The M.S. and Ph.D. programs are highly selective and limited in size (admitting 1 to 3 students per year across both programs). We aim to admit promising candidates with a keen interest in academic research. M.S. Requirements The program of study includes a minimum of 30 credit hours of coursework at the graduate level, plus a thesis. The degree requirements include: - 9-12 credit hours of advances marketing seminars (6000 level). - Minimum of 9 credit hours of research methods and statistics courses at the graduate level. Suggested courses include Business Research Methods (MGT 5124), Applied measurement (MGT 6224), Experimental Business Research (MKTG 6234) and Qualitative and Survey methods for Business research (MKTG 6105). - 6-9 elective credit hours at the graduate level in a related discipline or graduate-level business courses that would contribute to the student’s ability to design and conduct sophisticated research. - A comprehensive applied project entailing the design and implementation of appropriate marketing research skills, an examination covering the marketing literature and research methods, or a master’s thesis with up to 6 credit hours awarded. - A master's thesis. Up to 6 credit hours will be awarded for the thesis.

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: (100.0)

GRE

General: Verbal (159.0), Quantitative (164.0), Analytical (4.5)

GMAT

: Verbal (38.0), Quantitative (50.0), Analytical Writing Assessment (5.5), Total (690.0)

Ph.D. Overview The Doctoral Program in Marketing (Ph.D. in Business with Concentration in Marketing) is designed to develop graduates who assume positions as faculty members in research-oriented schools of business. The faculty has developed the doctoral program in marketing to provide challenging research and learning experiences for students seeking the skills to become leading researchers and communicators of advanced business knowledge. The key ingredients to the program’s success are its excellent students and its dynamic, research-oriented faculty who publish regularly in the leading marketing journals. In addition, faculty members are active in national marketing associations such as The American Marketing Association, The Association for Consumer Research, The Society for Consumer Psychology, and INFORMS Society of Marketing Science. The program is highly selective, rigorous, and personalized. The size of the program is strictly controlled to allow for intensive faculty-student collaboration. The required coursework provides rigorous exposure to the academic research literature in marketing as well as research methods and statistics. At the same time, we recognize that students bring a variety of interests and we will work with students to develop programs of study that will allow them to productively pursue those interests. The M.S. and Ph.D. programs are highly selective and limited in size (admitting 1 to 3 students per year across both programs). We aim to admit promising candidates with a keen interest in academic research. Ph.D. Requirements As the student advances through the doctoral program, the focus of the program shifts from coursework to research activity. Following completion of the doctoral seminars in the first year, each student is required to write a first-year research proposal paper; at the end of the second year, students are expected to write a more comprehensive second-year research proposal paper. The research papers serve as qualifying examinations. Students failing the qualifying examination, either in the first or second year, will be asked to leave the doctoral program. The program of study includes a minimum of 90 credit hours of coursework at the graduate level, plus a comprehensive project, examination, or a thesis. The degree requirements include: - Coursework in marketing content and theory, statistics, research methodology, and one supporting minor that should be consistent with the students interests and professional goals. - A series of marketing doctoral seminars focusing on marketing literature are required during the first two years of study such as MKTG 6105, 6106, 6204, 6304. - At least five courses of graduate research methods/statistics must be taken. Suggested courses include Business Research Methods (MGT 5124), Applied Measurement (MGT 6224), Experimental Business Research (MKTG 6234) and Qualitative and Survey Methods for Business Research (MKTG 6105). - A major aspect of learning is the student-faculty relationship. This one-on-one interaction is emphasized early in the program through research assistantships and independent studies. - Completion of a qualifying examination after the first year of studies to build on the work completed to date. Students failing the qualifying examination will be asked to leave the doctoral program. - Doctoral students are required to develop and present original research in seminar classes.

Students will be expected to submit original research, some co-authored with a member of the faculty, to major conferences and later to marketing journals. - Students are required during their third year of study to develop a dissertation proposal and defend it. This defense constitutes the University-required Preliminary Examination. - The fourth year of the doctoral program is focused on the pursuit of dissertation research. - The final oral examination, including the defense of the dissertation, is administered after completion of the dissertation.

GRADUATE COURSES (MKTG)

MKTG 5104:

Marketing Policy And Strategy

Principles and processes of strategic marketing planning. Emphasis on development and implementation of marketing plans and programs. Comprehensive case studies are used as the basis for analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ACIS 5104

Corequisite(s):

MKTG 5154:

Research for Marketing Decisions

The course encompasses: problem formulation, research design, data gathering instruments, scaling, sampling, data analysis for making marketing-related decisions, and solving marketing-oriented problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5104

Corequisite(s):

MKTG 5204:

Consumer Behavior

Consumer decision-making; information processing; perception; attitude; motivation; social and cultural influences on purchasing behavior; applications to marketing plan, target marketing, product development, distribution, pricing, and promotion.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5654

Corequisite(s):

MKTG 5264:

Pricing Strategy

Emphasis on pricing strategy. Economic, financial, legal, and marketing principles are integrated to analyze pricing decisions. Behavioral implications of pricing are also considered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5104

Corequisite(s):

MKTG 5304:

Promotion Strategy

Emphasis on understanding and applying the principles of marketing communication from a managerial perspective. Course examines the marketing communication activities of an organization focusing on the economic, sociological, and psychological aspects of behavior.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5104

Corequisite(s):

MKTG 5444:

Marketing, Management and the Public Purpose

The social context of business, with particular attention to marketing practices and entrepreneurial ventures. Examination of the public policy issues that arise from the pursuit of capitalist enterprise as well as the role of marketing and entrepreneurship in advancing social welfare and economic development. Multi-disciplinary approach linking historical, socio-cultural, political/legal, ethical, and strategic analyses in a global context.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5104, MGT 5314

Corequisite(s):

MKTG 5604:

Marketing Principles

An introduction to marketing management for executive MBA students. Considers the principles and processes of marketing planning in business and non-profit organizations. Executive MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5614:

Marketing Analysis and Strategy

Study of methods for analyzing customers (particularly market segmentation), diagnosing competitive market structure, and forecasting demand and the use of this information to develop marketing strategy. Executive MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5624:

Business Negotiations

This course addresses the practice of successful negotiations in business, including the business activities of marketing, operations, finance, and information management. This course utilizes behavioral principles of negotiation to develop and refine students understanding and practice of effective negotiating skills. Executive MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5634:

International Marketing Management

This course focuses on marketing decision making in a global context. The course includes consideration of the impact of culture, politics, and economics and the resulting differences in marketing institutions, marketing decision making, and marketing strategy.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5604

Corequisite(s):

MKTG 5654:

Managing the Mktg Function

Concepts of marketing management in a global environment, including the role of marketing in business organizations, and the relationship of marketing to other organizational functions. Role of marketing for developing and sustaining a competitive advantage in the marketplace, based of effective managerial decision making. Covers new product development and branding, as well as the characteristics of effective target marketing. Emphasis on the role of developing appropriate business intelligence for strategic decision making. Pre-requisite: Enrollment in the Executive MBA program

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5674:

Marketing in Dynamic Contexts

Strategic decision making to balance the interests of organizations (both profit and nonprofit) with those of society. Examination of public policy issues that arise from the pursuit of capitalist enterprise, as well as the role of marketing and entrepreneurship in advancing social welfare and economic development. Multi-disciplinary approach links historical, socio-cultural, political/legal, ethical, and strategic analyses in a global context.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5664 (UG)

Corequisite(s):

MKTG 5704:

International Marketing Strategy

This course provides the background to make managerial marketing decisions at the international level. It is composed of four sections: macro dimensions of international marketing, e.g., culture, politics, and economics; international comparative marketing systems; international marketing management decisions; and international strategic planning and control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5104

Corequisite(s):

MKTG 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

MKTG 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

MKTG 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

MKTG 6105:

Advanced Topics In Marketing

6105: Seminar in marketing theory, marketing research, buyer behavior, and marketing strategy. Emphasis on conceptual and methodological developments in marketing. 6106: Seminar in marketing management. Emphasis is placed on conceptual and methodological developments and quantitative decision models in promotion management, product and price management, channel of distribution management, and sales force management. May be repeated for credit up to 9 hours for each seminar with different content. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 6106:

Advanced Topics In Marketing

6105: Seminar in marketing theory, marketing research, buyer behavior, and marketing strategy. Emphasis on conceptual and methodological developments in marketing. 6106: Seminar in marketing management. Emphasis is placed on conceptual and methodological developments and quantitative decision models in promotion management, product and price management, channel of distribution management, and sales force management. May be repeated for credit up to 9 hours for each seminar with different content. II. Permission of Instructor.

Credit Hour(s): 3

Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MKTG 6105
Corequisite(s):

MKTG 6204:

Judgement and Decision Making Research in Marketing

Selective, intensive exposure to research in key substantive and methodological areas related to consumer and marketing managerial judgment and decision making. Design and implementation of original research. Key factors that influence consumer buying and marketing managerial decision making, including the role of utility theory; heuristics and biases; mental accounting and framing; risk; context effects; temporal effects; perceptual and cognitive processes; emotion; motivated and counterfactual reasoning; and motivational influences. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MKTG 6234:

Experimental Methods in Business Research

Experimental research methods for business research. Design of experimental studies, practical issues, and analysis of data. External, construct, and internal validity issues. Statistical techniques such as Analysis of Variance (ANOVA) and General Linear Model extensions. Hypothesis testing of causal mechanisms, result reporting, and replicability concerns. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MKTG 6244:

Advanced Quantitative Research Methods in Business

Theoretical foundations of quantitative research techniques used in business research. Sources of secondary data and primary data collection methods. Locating, reading, organizing, cleaning, and storing large datasets for model estimation. Statistical analysis using current statistical packages. Identification of natural experiments in business research and quantitative techniques to obtain the treatment effect. Application of methods to empirical research in all areas of business. Professional statistical result reporting in business research. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MKTG 6254:

Bayesian Methods and Applications in Business Research

Selective, intensive exposure to research in key substantive and methodological areas related to applications of Bayesian statistical methods in business research. In-depth coverage of contemporary conceptual and empirical Bayesian tools and applications in business disciplines, including fundamentals of Bayesian theory, Bayesian decision theory, approaches and algorithms used, selected business applications. Hands-on Bayesian model-building application. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MKTG 6264:

Applied Multivariate Statistics for Business Research

The underlying mathematics of multivariate statistical methods and illustrative research applications in the business disciplines. Topics include multivariate distributions, analysis of multivariate hypotheses; general linear models including regression and analysis of variance; supervised and unsupervised approaches to classification; dimension reduction and exploratory data analysis and confirmatory data analysis using structural equation models. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MKTG 6304:

Seminar in Buyer Behavior Research

This course applies current psychological, social psychological, sociological, communication, and economic theories and research to the study of buyer behavior phenomena. Emphasis is placed on recent research findings and methodologies in buyer behavior.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MKTG 5154

Corequisite(s):

MKTG 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MKTG 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CHEMICAL ENGINEERING

Steven Wrenn, Head

Emeriti Faculty: Donald Baird; David Cox;

Professors: Luke Achenie; Richey Davis; William Ducker; Erdogan Kiran; Yih-An Liu; Chang Lu; Padmavathy Rajagopalan; Steven Wrenn;

Associate Professors: Michael Bortner; Aaron Goldstein; Ayman Karim; Sheima Khatib; Stephen Martin; Abby Whittington; Hongliang Xin;

Assistant Professors: Sanket Deshmukh; Rong Tong;

Frank C. Vilbrandt Professor: Yih-An Liu;

Robert E. Hord, Jr. Professor: Padmavathy Rajagopalan;

Fred W. Bull Professor: Chang Lu;

Graduate Coordinator: carrieh7@vt.edu

Department Head: stevenpw91@vt.edu

Graduate Director: changlu@vt.edu

Department Site: http://www.che.vt.edu

Overview of ChE Graduate Program Chemical engineering has and will continue to play a prominent role in all realistic solutions to national and international problems of energy and the environment, health and medicine, and food and water. Progress toward solutions in these areas rests with judicious application of science. Such is the domain of the chemical engineer. The graduate plans of study in chemical engineering are heavily oriented toward synthesis with an emphasis on analysis. There is a strong thread of physics, chemistry, mathematics, biochemistry, and microbiology in much of the research in the department. Current thrust research areas include: data analytics (artificial intelligence and machine learning in the chemical engineering domain); sustainable and green energy (catalysis and surface science); health and medicine (biochemical and tissue engineering, biomaterials, nano- and precision-medicine). Traditional areas also remain active and in some cases overlap with the thrust areas: polymer chemistry and polymer science and engineering; colloid and surface chemistry; solid state chemistry and physics; nanotechnology; applied thermodynamics, molecular modeling; computer-aided design; and supercritical fluid science and technology. This representative list of topics gives an indication of the breadth and diversity of research areas in the department. Programs are also available for students with undergraduate degrees other than chemical engineering. Chemistry majors, especially those with thorough backgrounds in physical chemistry and mathematics, as well as graduates in biochemistry and microbiology, can re-orient their studies. The applied science nature of the research in the department facilitates this reorientation process for such students. Ph.D. programs to meet the needs of these students generally may require additional courses. The Ph.D. and M.S. degrees include a core of 12 credits in transport phenomena, thermodynamics, kinetics and mathematics. These courses are supplemented with electives chosen in support of the thesis research or the student's special interests. The Ph.D. is awarded only to those students who demonstrate the initiative and ability to carry through a significant research program, resulting in a thesis. A thesis is required of all M.S. degree students. Much of the research in the department involves multidisciplinary efforts; as such, chemical engineering students develop strong interactions with students and faculty in and out of the department and across colleges.

SPECIAL FACILITIES

The Chemical Engineering Department has state-of-the-art experimental facilities for the chemical, physical and biological characterization of materials. Computational resources include a departmental cluster and campus-wide supercomputing facilities.

Bio-Nanomaterials Lab

Faculty: Prof. Richey Davis Research in this lab concerns the self-assembly of polymers at interfaces and the engineering of nanostructured particles for drug delivery and medical imaging applications. A major focus is on the formation and characterization of nanoparticles with well-defined size distributions and compositions. The therapeutic payloads contained in the nanoparticles include small molecule drugs, peptides, and DNA. Imaging agents contained in the nanoparticles are used for characterizing biodistribution and consist of fluorophores for optical imaging and superparamagnetic iron oxide particles for MRI. The lab is equipped with instrumentation to characterize the size distributions, surface chemistry, compositions, and related properties of nanoparticles.

Biomaterial and Medical Device Laboratory (424 Holden Hall)

Faculty: Prof. Abby R. Whittington This laboratory focuses on design, fabrication and characterization of biodegradable or biologically relevant polymeric materials and their composites for use in medical devices, drug delivery systems, and tissue engineering. The facilities offer support for polymer and composite processing into nano/microparticles, films, hydrogels, and filaments with or without chemical modification. We seek to understand how material properties drive biological response through monitoring degradation rates, release kinetics, biocompatibility, changes in mechanical properties, and tissue formation.

Catalysis and In Situ/Operando Characterization Lab

Faculty: Prof. Ayman Karim Our research is multidisciplinary in the areas of nanomaterials synthesis, in situ/operando characterization, and heterogeneous catalysis. The work is focused on designing catalysts with molecularly tailored properties for shale gas utilization and automotive exhaust emission applications. The work involves detailed studies of the catalyst synthesis, in-situ/operando characterization of the structure under different conditions and during reaction and detailed measurements of the reaction kinetics to develop structure-reactivity correlations. The use of advanced in situ/operando characterization tools is the cornerstone of the research program including, spectroscopy (X-ray absorption and infrared), small angle X-ray scattering, microcalorimetry, transmission electron microscopy and others. Our ultimate goal is to determine how to tailor the catalyst's geometric and electronic properties to actively and selectively promote specific desired reaction pathways.

Colloidal and Surface Engineering Laboratory

Faculty: Prof. William Ducker This lab is focused on measuring the physical properties of colloidal particles and surface in liquids. State-of-the-art instruments are available for measuring rheology, zeta potential, particle size distribution, streaming potential, surface imaging (AFM, and fluorescence microscopy), adsorption (QCM, ATR-IR), and for handling bacterial suspensions. A major focus of the lab is understanding bacterial adsorption. The lab has facilities for BSL2 biosafety, and includes a biosafety cabinet and incubators.

Computational Catalysis Lab

Faculty: Prof. Hongliang Xin This lab focuses on understanding structure-function relationships of nanoscale materials for energy applications with a multi-scale modeling framework that integrates our expertise in ab-initio calculations, kinetic simulations, and statistical learning.

Computational Materials Design Lab

Faculty: Prof. Sanket Deshmukh Our research group is interested in creating new materials and biomaterials promising for use in a number of technologically important areas, such as energy, biomedicine, and tribology. By coupling statistical mechanical theory and newly developed multi-scale computational models in the group, we improve the fundamental understanding of the structure-property relationships in the existing materials with the assistance from supercomputers. A deeper understanding of the atomic-level structure and dynamics of the existing materials and proximal solvent molecules empower us to design new hybrid materials with predefined structure and function that can be used in next generation devices.

Drug Delivery and Biomaterials Lab

Faculty: Prof. Rong Tong Our work is at the interface of chemistry, materials science, nanotechnology and biotechnology, with interests in the following areas: (1) polymers and materials chemistry, in particular biodegradable polyester; (2) polymer biomaterials, in particular polymeric nanoparticles for drug delivery; (3) controlled release delivery system, including on-demand drug delivery for cancer therapy.

Lab for Center of Excellence in Process System Engineering

Faculty: Prof. Y. A. Liu A computational lab supported by sponsors of our graduate research and industrial outreach in process system engineering, such as Aspen Technology, Inc., SINOPEC and PetroChina. Current research focus on energy-saving design, validation and applications of CO2 capture and acid gas cleaning processes, adsorptive and chromatographic separations, polymer process modeling, monitoring, and advanced process control, big data analytics and machine learning in bioprocessing and chemical engineering.

Laboratory for Biomaterials and Tissue Engineering

Faculty: Prof. Padma Rajagopalan Research focuses on the development of model tissue constructs or functional tissue units and the study of cell-substratum interactions. A primary goal is to design tissue constructs that mimic the native structure of tissues in vivo and to systematically probe cellular response to a variety of cues. This involves the fabrication of biocompatible scaffolds and templates, and more importantly tailoring surface and bulk properties. Another research interest is to quantify cell-substratum interactions. Specifically studies focus on how chemical and mechanical properties of an underlying substratum affect cellular motility and contractility.

Membranes and Nanostructured Materials Laboratory

Faculty: Prof. Stephen Martin Research focuses on the synthesis, characterization and applications of soft and nanostructured materials, particularly those with applications for membrane separations and gas adsorption. A particular focus on the relationships between structure in materials, materials processing, and control of material properties for applications including water desalination, gas separations, and carbon capture. Specialized instrumentation in the lab includes equipment for X-ray Scattering (WAXD), optical microscopy, spin coating, contact angle goniometry, liquid chromatography, gas chromatography, isothermal adsorption gravimetry, gas and liquid permeation (single gas, mixed gas, membrane chromatography, and reverse osmosis) and packed bed gas adsorption.

Microfluidics Lab

Faculty: Prof. Chang Lu Development of microfluidic devices for studying cells and biomolecules.Research also focuses on understanding microscale fluid mechanics.

Multiscale and Multiphysics Modeling Lab

Faculty: Prof. Luke Achenie This facility specializes in molecular to macro-scale modeling, data science and scientific computing. We use modeling techniques such as molecular dynamics, quantum mechanics, machine learning, agent-based modeling and differential equations (ordinary, partial and integral). There are applications to membranes, surfactants, oral drug delivery, chemical/reactive processes and biomedical problems of current interest. The facility has a medium size Beowulf style high performance computing environment.

Nano Energy and Environmental Catalysis Lab

Faculty: Prof. Huiyuan Zhu Our research interest primarily focuses on synthetic engineering of nanostructured catalysts with rationally designed interfacial architectures, including metal-metal, metal-oxide, metal-ligand and metal-inorganic support, to achieve desired catalytic properties for sustainable energy and environmental applications. We investigate the atomic-scale architectures and the accompanying electronic and geometric effects on catalysis for small molecule (O2, CO2, N2, CO, CH4, etc.) activation and conversion. Our research aims to address the ultimate scientific challenge as how to modulate the reaction pathway to actively and selectively convert small molecules in our atmosphere to commodity chemicals and fuels.

Polymer and Composites Materials Laboratory

Faculty: Prof. Michael Bortner The PCML focuses on polymer composite processing and resulting morphology and structure property relationships, spanning macro to nano-scale polymer composites. Core research areas include advanced manufacturing approaches for rapid fabrication of carbon fiber based composites, process modeling and materials development for polymer based additive manufacturing, development of novel nanoscale interfacial/interphase characterization analyses in thermosetting polymer nanocomposites, and processing/applications of cellulose nanocrystals (CNCs). Specialized equipment includes high temperature (bed/melt)), multi-material extrusion custom additive manufacturing machines; modulated DSC; DMA; capillary and microcapillary rheometers; FTIR + MCT, ATR; laboratory scale extrusion, ultra high T (2200°C) vacuum furnace, Instron loadframe (500N-50kN, various geometries), high energy ball milling, Zeiss stereoscope (motorized stage and ZEN z-stacking hardware/software).

Skeletal Tissue Engineering and Mechanobiology Lab

Faculty: Prof. Aaron Goldstein Research concerns the fabrication of biocompatible polymer scaffolds for the regeneration of bone, muscle, tendon and ligament tissues. Our goal is to fabricate materials that can provide chemical, biochemical, mechanical, and topographic cues to guide stem cells to migrate, proliferate, and differentiate into various skeletal tissues. In addition, we are interested in constructing composite and spatially graded materials that could lead to the regeneration of heterogeneous tissues such as the bone-to-ligament transition. Finally, we are interested in understanding how mechanical stimuli (e.g., tensile strain, hydrodynamic shear) act in concert with biomaterial scaffolds to affect expression of skeletal tissue phenotypes and deposition of bioactive extracellular matrix proteins.

Supercritical Fluids and High Pressure Lab

Faculty: Prof. Erdogan Kiran This is a highly specialized laboratory for investigations of thermophysical properties of dense or supercritical fluids and fluid mixtures at high pressures, up to 1000 bar at 200oC. The focus is on thermodynamic and kinetic aspects of miscibility and phase separation and transport properties of dense fluid mixtures with emphasis on applications for polymer formation, modification and processing. Polymer miscibility and phase equilibria, polymer crystallization, and morphological modifications, polymer foaming and generation of micro or nanoporous materials in supercritical fluid mixtures, and assessment of high pressure viscosity of polymer solutions and lubricants are among the active research areas.

DEGREES OFFERED

MEng Degree

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0), (0.0)

MEng (Project & Report) - Total of 30 credit hours. minimum of 24 graded credit hours maximum of 6 credit hours of Project & Report (5904) may include maximum of 6 credits of 4000-level undergraduate course work all other graded course work must be 5000-level or higher and may include: 3 credits of seminar and a maximum of 9 credits total in 5974, 5984 and 6984 MEng (non-thesis) - Total of 30 credit hours* minimum of 30 graded credit hours may include a maximum of 6 credits of 4000-level undergraduate course work all other graded course work must be 5000-level or higher and may include: 3 credits of seminar and a maximum of 9 credits total in 5974, 5984 and 6984 *The MEng (non-thesis) degree is usually reserved for PhD students wishing to earn a MEng degree on the way to their PhD degree.

PhD Degree

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

PhD - Total of 90 credit hours. minimum of 27 graded credit hours may include a maximum of 6 credits of 4000-level undergraduate course work all other graded course work must be 5000-level or higher and may include: 4 credits of seminar and a maximum of 18 credits total in 5974, 5984 and 6984 minimum of 30 credit hours of Research & Dissertation

(7994)

MS Degree
TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

MS (thesis) - Total of 30 credit hours. minimum of 20 graded credit hours may include a maximum of 6 credits of 4000-level undergraduate course work all other graded course work must be 5000-level or higher and may include: 3 credits of seminar and a maximum of 6 credits total in 5974, 5984 and 6984 minimum of 6 credit hours of Research & Thesis (5994)

GRADUATE COURSES (CHE)

CHE 5014:

Communication Skills and Methods of Presentation

Methods and style to make effective technical and nontechnical presentations including blackboard presentations, overhead presentations, slide presentations, and research posters. Video presentations with critiques.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5034:

Introduction to Polymer Materials

Homopolymerization, copolymerization, polymer, architecture, morphology, thermal transitions, vitrification, crystallization, polymer solutions, blends, thermodynamics of miscibility and phase behavior, and mechanisms and kinetics of pressure- or temperature- induced phase separation, formation of particles, fibers, porous matrices or scaffolds, and novel technologies employing modifications and processing in or with dense or supercritical fluids, or ionic liquids. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5044 (BSE 5044) (BMES 5044):

Engineering Mathematics

Introduction to numerical solutions of partial differential equations using the finite element method in one-, two-, and three-dimensions with direct relevance to chemical engineering, biological systems engineering and biomedical engineering and sciences. Partial differential equations and ordinary differential equations using finite differences, model parameter sensitivity analysis, optimization, and data analysis. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5094:

Advanced Chemical Engineering Kinetics

Fundamental principles of chemical kinetics applied to the analysis and design of chemical reactors.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHE 3184

Corequisite(s):

CHE 5125:

Transport Phenomena

Fundamentals aspects of transport of mass and chemical reaction. Application to complex chemical engineering problems. Advanced mathematical techniques, fundamental aspects of transport of mass, and chemical reaction. Application to complex chemical engineering problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (CHE 3044 (UG), CHE 3144 (UG)) OR (CHE 3044, CHE 3144)

Corequisite(s):

CHE 5126:

Transport Phenomena

Fundamentals aspects of transport of mass and chemical reaction. Application to complex chemical engineering problems. Advanced mathematical techniques, fundamental aspects of transport of mass, and chemical reaction. Application to complex chemical engineering problems.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (CHE 3044 (UG), CHE 3144 (UG), CHE 5125 (UG)) OR (CHE 3044, CHE 3144, CHE 5125)

Corequisite(s):

CHE 5144:

Advanced Thermodynamics

Fundamentals of physical and chemical equilibria, statistical thermodynamics, and applications to situations of current special interest.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHE 2164 (UG)

Corequisite(s):

CHE 5214:

Polymeric Biomaterials

Topics include polymer design and processing, inflammatory responses to polymers, interaction of blood with polymeric materials, and the effect of mechanical, chemical, and surface properties of polymers on cells. The culmination of this course will provide students with the knowledge to successfully design polymer-based biomaterials, drug-delivery devices, and bio-implants. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5304 (BMES 5304):

Biological Transport Phenomena

The fundamental principles of mass transport phenomena will be introduced and applied to the characterization of transport behavior in biological systems (e.g., cell, tissues, organs, people). Topics will include active, passive, and convective molecular transport mechanisms. These fundamentals will be used to develop analytical and predictive models that describe phenomena such as oxygen transport, kidney function, systemic drug delivery, and design of extracorporeal devices. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (CHE 3114 (UG) OR CHE 3114), (CHE 3044 (UG) OR CHE 3044 OR CHE 3144 (UG) OR CHE 3144) OR (ME 3304 (UG) OR ME 3304, ME 3404 (UG) OR ME 3404)

Corequisite(s):

CHE 5304G:

Advanced Biological Transport Phenomena

Engineering analysis and predictive modeling of heat and mass transport in biological systems (e.g., tissues, organs, organisms, and biomedical devices). Examination of processes that involve conduction, convection, diffusion, generation/ consumption. Application of analytical and computational methods to solve differential equations that describe unsteady and/or multi-dimensional transport. Topics include oxygen transport, drug delivery, pharmacokinetic analysis, kidney function, blood perfusion, cryopreservation, and hyperthermia. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5334G:

Colloid and Interface Science

Properties and behavior of colloidal systems, primarily in liquid environments. Size characterization and description, Brownian motion, interparticle forces, dispersion stability, and experimental techniques for characterizing these systems. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5404:

Machine Learning in Chemical Sciences and Engineering

Data-driven machine learning models in chemical sciences and engineering for materials discovery, property prediction, anomaly, detection, process optimization. Data preprocessing, data management and visualization, clustering, classification/regression algorithms, uncertainty quantification, Bayesian statistics, and open access tools. Common pitfalls and practices. Potential bias and ethical issues in training and evaluation of machine learning models. Pre: Graduate

standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHE 5414:

Explainable AI for Domain Insights

Interpretability and its importance for machine learning in chemical sciences and engineering. Integration of scientific principles into machine learning including Bayesian inference of physical models from data and physics-informed neural networks. Feature importance analysis for local and global interpretations. Performance metrics for evaluating interpretation algorithms. Open-source libraries for interpretation. Applications of explainable artificial intelligence (AI) for materials design and process engineering. General tradeoffs between model performance and interpretability. Common pitfalls of explainable AI and their solutions.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHE 5404
Corequisite(s):

CHE 5424:

Computational and Data Sciences for Materials Design

Computational modeling and data science techniques for the design of new materials. Data curation from material databases and literature. Data generation by multiscale simulations of materials. Supervised and unsupervised machine learning models. Evolutionary optimization and reinforcement learning algorithms, materials property prediction, materials screening from existing databases, inverse design of materials with desired properties. Advantages and limitations of different approaches and assessment of different steps involved in materials discovery.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHE 5404, CHE 5414
Corequisite(s):

CHE 5434:

Computational and Data Sciences for Process Engineering

Data curation and preprocessing, handling time series data, design of experiments, machine learning algorithms, optimization, design rules and analysis of physics-based process models in chemical sciences and engineering domains. Case studies on industrial problems in process design, optimization, control, operations, supply chain, scheduling, planning, and monitoring.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHE 5404, CHE 5414
Corequisite(s):

CHE 5544G (BSE 5544G):

Advanced Protein Separation Engineering

Concepts, principles and applications of various unit operations used in protein separations. Properties of biological materials, such as cells and proteins, and their influences on process design. Design of processes for protein purification based on the impurities to be eliminated. Concepts and principles of scale-up of unit operations. Case studies in practical protein recovery and purification issues, with a focus on enhanced protein purification by genetic engineering. Protein purification process simulation and optimization using process simulation software. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHE 3144 (UG) OR BSE 3504 (UG)
Corequisite(s):

CHE 5564:

Non-Newtonian Fluid Mechanics

Development of fluid models which describe the mechanical response of non-Newtonian fluids. Use of these models with the basic equations of continuum mechanics is emphasized.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHE 3114 (UG) OR CHE 3114
Corequisite(s):

CHE 5904:

Project and Report

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CHE 5944:

Chemical Engineering Seminar

This course is designed to improve a students ability to present formal seminars concerned with technical and nontechnical information. Numerous presentations are given by each student enrolling in this class.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

CHE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CHE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CHEMISTRY

Amanda Morris, Chair

Emeriti Faculty: Harry Gibson; David Kingston; Herve Marand; Judy Riffle; Sam Turner;

Professors: Paul Carlier; Daniel Crawford; Harry Dorn; Alan Esker; Felicia Etzkorn; Richard Gandour; Timothy Long; Louis Madsen; John Matson; Joseph Merola; Robert Moore; John Morris; Amanda Morris; Webster Santos; James Tanko; Diego Troya; Eduard Valeyev;

Associate Professors: Paul Deck; Feng Lin; Guoliang Liu; Gary Long; Nicholas Mayhall; Brian Tissue; Gordon Yee;

Assistant Professors: Charles Figg; Emily Gentry; Andrew Lowell; Emily Mevers; Lina Quan; Michael Schulz; Diana Thornton; Valerie Welborn;

University Distinguished Professor: Daniel Crawford;

Dr. A. C. Lilly, Jr., Faculty Fellow of Nanoscience: John Matson;

Graduate Contact: jolih@vt.edu

Graduate Program Director: aesker@vt.edu

Graduate Admissions Director: fenglin@vt.edu

Graduate Site: https://chem.vt.edu/academics/graduate.html

Student Handbook: https://chem.vt.edu/content/dam/chem_vt_edu/grad/GraduateOrangeBook_July2022.pdf

Admissions: https://chem.vt.edu/graduate/prospective-students.html

The Chemistry Department is consistently top-ranked among its peers in terms of degree production (BA, BS, MS, & PhD) and research expenditures. Our 30 faculty members and 140 graduate students generate over 100 peer-reviewed publications per year and have earned numerous prestigious awards for research, teaching, and outreach. In addition to the major areas of chemistry (analytical, inorganic, organic, and physical), our polymer chemistry program has been ranked among the top 5, and we have highly developed programs in several interdisciplinary areas including drug discovery, computational and theoretical chemistry, surface science, renewable energy, and chemical biology.

SPECIAL FACILITIES

The Chemistry Department is housed in three adjoining buildings. Davidson Hall is the original chemistry building, which has recently undergone renovation. Davidson Hall features both classrooms and research laboratories. Hahn Hall South Wing is exclusively devoted to research, and the building features a lovely atrium gathering space. Hahn Hall North Wing houses our teaching laboratories and several conference rooms. Additional research space is occupied by the Chemistry Department in the Institute for Critical Technologies and Applied Science (ICTAS).Other equipment available to Chemistry researchers includes an 1100-node supercomputer (System X), several smaller computational clusters and a broad range of microscopy equipment (AFM, STM, SEM, and optical) and nanoscale fabrication hardware.

Analytical Services Center

Our Analytical Services Center houses seven NMR spectrometers, including a 600 MHz, a 500 MHz, four 400 MHz (including a wide-bore instrument for imaging experiments) and a 300 MHz instrument dedicated to solid samples. Both the 600 and 500 Mhz instruments use modern Bruker Prodigy probes cooled to liquid nitrogen temperatures for greatly enhanced sensitivity. All modern techniques (multidimensional, multinuclear, variable temperature) are available. The NMR facility also houses an EPR system complete with LN2 and LHe variable temperature capability. The Analytical Services Center also includes several HPLCs, GCMS, Circular Dichroism, and UV-vis capability. The analytical labs are fully staffed with professional spectrometrists.

College of Science -- Crystallography Laboratory

Our X-ray diffractometer is housed in the College of Science Crystallography Laboratory (VTX), which features a range of diffractometers and a capabilities such as variable temperature (100-500K), high pressure (to 10 GPa), and the ability to analyze small crystals and proteins.

Polymer Characterization Laboratory

The Polymer Characterization Laboratory features a comprehensive suite of thermal analysis instruments including: DMA, TGA, DSC, and water sorption analyser, as well as mechanical, rheological testing instruments, and a twin-screw extruder. The lab also houses a polarized light microscope with hot stage, and a benchtop SEM.

Surface Analysis Laboratory

The Surface Analysis Laboratory features Electron Spectroscopy for Chemical Analysis (ESCA), Auger Electron Spectroscopy (AES), and Infrared Spectroscopy (IR).

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

IELTS

General Test: (6.5)

This section offers brief synopses of the programmatic requirements for the M.S. and Ph.D. degrees in Chemistry at Virginia Tech. Applicants and current students are directed to our policies and procedures manual for the complete, detailed description of these requirements. The link to the manual can be found on the Current Students section of our website: https://chem.vt.edu/academics/graduate/current-students.html The M.S. degree may be earned in one of two ways. The student may prepare and defend a Master's Thesis; alternatively there is a non-thesis M.S. option that is based exclusively on course work. The Thesis M.S. degree requires 20 credit hours of graduate course work, the presentation of one seminar, and the preparation and oral defense of the M.S. thesis. The non-thesis M.S. degree requires 24 credit hours of regular graduate course work plus 6 credit hours of report-based courses.

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

IELTS

General Test: (6.5)

This section offers brief synopses of the programmatic requirements for the M.S. and Ph.D. degrees in Chemistry at Virginia Tech. Applicants and current students are directed to our policies and procedures manual for the complete, detailed description of these requirements. The link to the manual can be found on the Current Students section of our website: https://chem.vt.edu/academics/graduate/current-students.html Each doctoral student must complete a minimum of four graduate-level courses. The selection of courses depends on the student's research interests and are established in consultation with the student's Advisory Committee. Some additional courses may be recommended to ensure that the student has a broad Foundation of knowledge; these courses are determined by the student's performance on entrance examinations in Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Instrumental Analysis, and Biochemistry administered during Orientation Week. Each doctoral student also must complete two report courses; in the first enrollment (3rd semester of residence) a Literature Review is prepared, and in the second enrollment (6th semester of residence) an Original Research Proposal is prepared. Each doctoral student also must present two seminars and satisfy annual reporting and evaluation requirements as specified in the document linked above.

GRADUATE COURSES (CHEM)

CHEM 5004:

Orientation to Graduate Research

A survey of topics needed to meet high standards of safety, scholarship, and productivity in research-based chemistry graduate programs. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5014:

Communication Skills and Methods of Presentation

Methods and style to make effective technical and nontechnic presentations including blackboard presentations, overhead presentations, slide presentations, and research posters. Video presentations with critiques.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5094 (BMVS 5094) (FST 5094):

Grant Writing and Ethics

A framework for writing clear, concise grant proposals in a team-oriented, multidisciplinary approach from concept development through submission to a funding agency. Potential ethical dilemmas that may arise in academic, industrial, or federal research settings will be discussed. Pre: Undergraduate courses in one of the following: organic chemistry (CHEM 2565/2566), cell & molecular biology (BIOL 2104), Concepts of Biochemistry (BCHM 2024), or equivalent. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5114:

Advanced Electrochemistry

Discussion of theory and application of chemical equilibrium, reaction rate methods, and electroanalytical methods in analytical chemistry. One year of physical chemistry required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5124:

Analytical Spectroscopy

Principles, instrumentation, and applications of atomic and molecular spectroscopy. Theoretical descriptions of electronic and ro-vibrational energy levels, transitions, and energy dynamics. Modern spectroscopic instrumentation and applications in quantitative analyses. Prerequisite or equivalent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   CHEM 3616 (UG) OR CHEM 36616

Corequisite(s):

CHEM 5134:

Introduction to Single-Crystal X-ray Diffraction

Overview of single-crystal X-ray crystallographic theory and methods for graduate students who make (or plan to make) occasional use of crystallographic data or measurements in their research. Capabilities and services of the Virginia Tech X-ray Crystallography Service Center (VTX). Preparation and submission of crystalline samples. Typical processes of crystal screening, data collection, structure solution, and data reporting. Current standards for publication of crystallographic data. Crystallography software and structural databases. Ethical standards for reporting crystallographic data. Radiation safety in crystallography. Pre: Graduate standing. Pass/Fail only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5144:

Instrument Design

Design, construction, and operating principles of analytical instrumentation. Topics will include major instrument components (vacuum, optical, charged-particle), instrument construction (spectrometers, chromatographs), electronic data acquisition, and computer data analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5174 (ESM 5174):

Polymer Viscoelasticity

Constitutive models of linear viscoelastic materials, experimental aspects, polymer response to mechanical and electrical inputs, solid state NMR and microwave interactions with polymers, free volume

theories, temperature and environmental effects on polymers, physical aging of glasses. Consent required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 5404:

Advanced Inorganic Chemistry

An advanced coverage of topics in inorganic chemistry: principles of bonding in compounds of the metals and non-metals, applications of group theory to bonding, ligand field theory, inorganic and organometallic reaction mechanisms. Required core course for chemistry graduate students. One semester of undergraduate inorganic chemistry, one year undergraduate physical chemistry required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 5414:

Methods & Appl of Inorg Chem

Physical methods of measurement in modern inorganic chemistry research. Theoretical and practical aspects of spectroscopy, electrochemistry, photo-chemistry, and surface-analytical techniques as applied to inorganic compounds. Intersections of inorganic chemistry with nanotechnology, materials science, heterogeneous catalysis, and biochemistry, as reflected in the primary research literature. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 5424G (SBIO 5424G):

Adv Polysaccharide Chemistry

Structure, properties, and application of natural polysaccharides. Natural sources and methods of isolation. Synthetic chemistry and important polysaccharide derivatives Relation of structure and properties of performance in critical applications including pharmaceuticals, coatings, plastics, rheology control, and films. Conversion by chemical and biochemical methods of polysaccharide biomass to fuels and materials. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 5505:

Advanced Organic Chemistry

Structure, stereochemistry, and bonding in organic compounds and their effects on organic reactivity. Ionic reactions, free radical reactions, and concerted reactions will be discussed. One year of undergraduate organic chemistry required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 5506:

Advanced Organic Chemistry

Structure, stereochemistry, and bonding in organic compounds and their effects on organic reactivity. Ionic reactions, free radical reactions, and concerted reactions will be discussed.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHEM 5505 (UG) OR CHEM 5505
Corequisite(s):

CHEM 5514G:

Advanced Green Chemistry

Sustainability, waste prevention, conservation of energy resources, avoidance of toxins, pollutants, and hazards in chemical processes and products. Life-cycle analysis applied to case studies involving process development and product stewardship. Applications in chemical industry, process and product design, and public policy. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 5524:

Molecular Structure Determination

Structure determination of organic compounds by spectroscopic methods, with an emphasis on mass spectrometry and nuclear magnetic resonance. Course will emphasize problem-solving skills. Includes hands-on instruction in nuclear magnetic resonance spectroscopy and other analytical spectroscopic methods. Partially duplicates 4524; students cannot receive credit for both 4524 and 5524.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): CHEM 2536 (UG), (CHEM 3616 (UG) OR CHEM 4616 (UG)) OR CHEM 2536, (CHEM 3616 OR CHEM 4616)

Corequisite(s):

CHEM 5525 (GEOS 5535):

X-ray Crystallography

5525: Provides a thorough grounding in the principles of the crystalline state including lattices and symmetry, leading to the formal description of structures and surfaces and interpretation of published crystallographic data. 5526: Covers methods of single-crystal and powder X-ray diffraction for the determination of the atomic arrangement of atoms within crystalline materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GEOS 3504 OR CHEM 3615

Corequisite(s):

CHEM 5526:

X-Ray Crystallography

5525: Provides a thorough grounding in the principles of the crystalline state including lattices and symmetry, leading to the formal description of structures and surfaces and intrepretation of published crystallographic data. 5526: Covers methods of single-crystal and powder X-ray diffraction for the determination of the atomic arrangement of atoms within crystalline materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GEOS 5535 OR CHEM 5525

Corequisite(s):

CHEM 5535:

Synthetic Organic Chemistry

Modern synthetic methods and their applications to the preparation of various classes of organic compounds.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5505 (UG) OR CHEM 5505

Corequisite(s):

CHEM 5614:

Nuclear Magnetic Resonance Methods in Chemistry and Polymer Science

Theory and methods of nuclear magnetic resonance (NMR). Description and operation of NMR apparatus and experimental techniques. Optimization of NMR experiments with respect to spin relaxation, sensitivity, and resolution. Spin couplings and associated spectral features. Applications in the characterization and analysis of molecules, solids, and polymers. Theory and basic practices of solution, solid-state, and multidimensional NMR methods. Spatial imaging (MRI) and molecular diffusion (diffusometry) methods. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5644:

Colloid and Surface Chemistry

Characterization of interfaces including liquid/gas and liquid/liquid (spread monolayers) interfaces, nature of solid surfaces, gas/solid (thermodynamics), and liquid/solid (wetting, colloidal stability) interfaces. Pre: One year of physical chemistry or consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5664:

Chemical Kinetics

Phenomenological kinetics with emphasis on measurement techniques and the interpretation of kinetic data. Significance of rate laws, activation parameters for mechanisms, catalysis and fast reactions in gas and condensed phase are discussed. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5834:

Food, Energy, and Water Chemistry

Roles of chemistry in food production, energy utilization, and water management. Integration of sustainable food-energy-water (FEW) chemistry in progress toward environmental stewardship and resource efficiency. Principles of equilibria and speciation, reaction kinetics, wet-analytical and instrumental methods, synthesis, and physical characterization of materials emphasizing applications of FEW chemistry including water-purification materials and green agrochemical production. Analysis of current academic and patent literature describing developing chemical technologies relevant to the food, energy, and water nexus. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5854:

Entrepreneurship in Medicinal Chemistry

History of entrepreneurship in medicinal chemistry. Survey of industrial medicinal chemistry sectors from small ventures to major pharmaceutical companies. Business plan development and venture capitalism. Case studies of medicinal chemistry ventures. Business and legal aspects of translating scientific discovery into intellectual property (IP), industrial processes, and competitive advantage. Academic technology-transfer procedures. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5894:

Final Examination

For non-thesis candidates who are required to register for their final examination and have completed their program of study. Not to be included in minimum hours required for degree.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5904:

Project and Report

A detailed written report on a current topic in chemistry or interdisciplinary areas involving chemistry. Non-thesis M.S. students in chemistry are required to complete 4 credit hours of CHEM 5904. Graduate standing in chemistry required.

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CHEM 5914:

Literature Review and Research Plan

Preparation of a written review of a topical research area within chemistry or a closely allied interdisciplinary field. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5944:

Graduate Seminar

Recent advances in various fields of chemistry are covered by means of reports carefully prepared and presented by individual students, under direction of various members of chemistry faculty. Work of each student is judged not only by report he gives but also by an intelligent discussion of reports presented by other students.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

CHEM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CHEM 6434:

Organometallic Chemistry

Chemistry and applications of organometallic and related compounds.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 6464:

Current Topics in Inorganic Chemistry

Special topics in frontier areas of inorganic chemistry. Offered when appropriate.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 6504:

Chemistry of Natural Products

The structures, biosyntheses, reactions, and biomimetic syntheses of natural products, with examples from each of the major classes of polyketides, shikimates, terpenoids, alkaloids, antibiotics, and marine natural products.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5506 (UG) OR CHEM 5506

Corequisite(s):

CHEM 6564:

Current Topics in Organic Chemistry

Special topics in frontier areas of organic chemistry. Offered when appropriate. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5506 (UG) OR CHEM 5506

Corequisite(s):

CHEM 6624:

Chemical Thermodynamics

Rigorous application of the laws of thermodynamics to real fluids, solutions, chemical equilibria, and non-equilibrium processes. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CHEM 6634:

Quantum Chemistry and Spectroscopy

Study of basic quantum mechanics followed by some of its applications to chemistry and spectroscopy. Topics include: the variational method; perturbation theory; Hartree-Fock theory; the electronic structures of atoms and molecules; atomic spectra; and molecular rotational, vibrational, and electronic spectra. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 6664:

Current Topics in Physical Chemistry

Special topics in frontier areas of physical chemistry. Offered when appropriate. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 6904:

Generating Research Ideas

Process of generating and evaluating novel research ideas in chemistry. Pre: Graduate Standing.

Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 6914:

Original Research Proposal

Preparation of a written original research proposal in chemistry or a closely related interdisciplinary field. Must have passed the Preliminary Oral Exam.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHEM 5914
Corequisite(s):

CHEM 6984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CHEM 7994:

Research and Dissertation

Credit Hour(s): 1 TO 20
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

CIVIL ENGINEERING

Mark Widdowson, Head

Emeriti Faculty: Gregory Boardman; Finley Charney; Thomas Cousins; William Cox; J Duncan; Randel Dymond; William Easterling; George Filz; David Kibler; Matthew Mauldon; James Mitchell; Thomas Murray; John Novak; Raymond Plaut; Clifford Randall; Kamal Rojiani; Dusan Teodorovic; Michael Vorster; Richard Weyers; Jesus de la Garza;

Professors: Montasir Abbas; Thomas Brandon; Scott Case; Andrea Dietrich; Matthew Eatherton; Marc Edwards; Gerardo Flintsch; David Ford; Daniel Gallagher; Michael Garvin; Stanley Grant; Russell Green; Jennifer Irish; William Knocke; Roberto Leon; John Little; Linsey Marr; Amy Pruden-Bagchi; Hesham Rakha; Carin Roberts-Wollmann; Adrian Rodriguez-Marek; Sunil Sinha; Antonio Trani; Peter Vikesland; Mark Widdowson;

Associate Professors: Hosein Foroutan; Kathleen Hancock; Erich Hester; Susan Hotle; Gabriel Isaacman-VanWertz; Farrokh Jazizadeh Karimi; Ioannis Koutromanos; Sherif Lotfy Motaleb Abdelaziz; Earl Shealy; Kyle Strom;

Assistant Professors: Monica Arul Jayachandran; Alexander Brand; MD SAMI HASNINE; Eric Jacques; Jingqiu Liao; Landon Marston; Frederick Paige; Megan Rippy; Siddharth Saksena; Rodrigo Sarlo; Invalid Use 906564030 David Munoz Pauta; Joseph Vantassel; Alba Yerro Colom;

Professor of Practice: Joseph Dove; Bryan Katz;

University Distinguished Professor: Marc Edwards;

Dan Pletta Professor: Gerardo Flintsch;

University Distinguished Professor, Charles P. Lundsford Professor: Linsey Marr;

W. Thomas Rice Professor and University Distinguished Professor: Amy Pruden-Bagchi;

Samuel Reynolds Pritchard Professor: Hesham Rakha;

Nick Prillaman Professor: Peter Vikesland;

David H. Burrows Professor: Roberto Leon;

Assistant Professor of Practice: Michael Biscotte; Robert Scardina;

Associate Professor of Practice: Claire White; Kevin Young;

Charles E. Via, Jr. Professor: John Little;

Reynolds Metals Professor: Scott Case;

Vecellio Professor: David Ford;

Graduate Contact: shmartin@vt.edu

Extended Campus Contact: shmartin@vt.edu

Graduate Student Policy Manual:

https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

Graduate Site: https://cee.vt.edu/Graduate-menu/prospective_graduate_students.html

The Charles E. Via, Jr. Department of Civil and Environmental Engineering awards the Master of Science in civil engineering, the Master of Science in environmental engineering, the Master of Engineering in civil engineering, and the Doctor of Philosophy in civil engineering. A Master of Science degree in environmental sciences and engineering are also administered within the department. For the civil engineering degrees, students may emphasize one or more of 10 discipline areas available for graduate study within the Department: civil engineering materials, civil infrastructure engineering, construction engineering and management, environmental engineering, geospatial engineering, geotechnical engineering, sustainable land development engineering, water resources engineering, structural engineering, and transportation engineering. A minor may also be taken in one or more of the alternate branches of engineering or in an allied field, such as mathematics, engineering mechanics, chemistry, geology, or urban and regional studies. As part of a land-grant University, the department strives to provide a mix of applied and theoretical learning and research opportunities. Success of our goals is achieved by offering attractive graduate study opportunities and graduate programs that are relevant for current global challenges. Today, the graduating classes typically include approximately 100 MS degrees, and 15 Ph.D. degrees. The graduate enrollment of approximately 275-350 on the main campus and about another 25 students at extended campuses make this program one of the largest in the Southeast. The department ranks in the top 10 civil engineering and environmental engineering programs in the United States. The department has 48 tenured/tenure-track faculty and 21 emeritus faculty members, many of whom actively engaged with the department. Additionally, the department has 26 other faculty members which includes professors of practice, research faculty and administrative faculty. The department also is supported by 18 staff members. Three faculty are members of the National Academy of Engineering, one is a member of the National Academy of Science, two are members of the National Academy of Construction, and ten hold prestigious named professorships. Fifteen members of the faculty have been awarded Presidential Young Investigator, National Young Investigator, or CAREER awards from the National Science Foundation. Two have been awarded the prestigious PECASE Award and seven have been awarded the State Council of Higher Education for Virginia Outstanding Faculty Award. Faculty members within the department have received numerous national and regional awards for their teaching, research, scholarship and outreach activities. Financial resources are available to support graduate students via a variety of funding mechanisms. The department annually awards the full-time equivalent of more than 60 graduate teaching assistantship positions. In addition, annual research expenditures (averaging approximately $15 million dollars) provide numerous opportunities for students to receive graduate research assistantships. Finally, the Via Endowment (established at $5 million dollars in 1987, now valued at nearly $15 million dollars) provides special funds for fellowships that support the highest quality M.S. and Ph.D. students (U.S. citizenship or permanent residency required for Via support) who pursue graduate studies in the department. The Via Endowment also provides special stipend support for a select number of Ph.D. students who receive an opportunity to pursue classroom instruction each year. While the majority of the department's graduate activities occur in Blacksburg, there are also opportunities available in other areas of the Commonwealth of Virginia. Four full-time faculty, who specialize in Environmental & Water Resources Engineering are located at the Occoquan Watershed Monitoring Laboratory in Manassas, Virginia (northern part of the state). A number of environmental and water resources graduate students conduct research in the Hampton Roads area in association with adjunct faculty at the Hampton Roads Sanitation District.

SPECIAL FACILITIES

The CEE department has a wide range of facilities to support its teaching and research goals.

CEECL Computer Laboratory

This instructional lab provides multimedia equipment (Computer, VCR, ELMO, LT) for faculty/staff to instruct audiences in the use of installed engineering software. The podium allows an instructor to project two independent video signals simultaneously on two separate screens. The primary purpose of this room is instruction for CEE courses and special classes

Kelso Baker Environmental Hydraulics Lab

Baker Environmental Hydraulics Laboratory (BEHL) is a 3100 square ft floor area facility, housing several research flumes and a wide variety of advanced research instrumentation and hydraulic measurement systems. The laboratory is devoted to environmental hydraulics related research.

Materials Laboratory

The materials laboratory provides 7700 sq. ft. of research space and contains equipment for evaluation of the performance of concrete and asphalt. Concrete and concrete- making materials performance evaluation equipment include rapid and critical dilation freezing and thawing cabinets, a computer-driven microscopic air void analysis apparatus, corrosion rate measuring devices, state-of the-art image analysis system, petrographic microscope, and facilities for wet chemical analysis.

Occoquan Monitoring Laboratory (Manassas, VA)

The Occoquan Watershed Monitoring Laboratory (OWML), Manassas, is responsible for making determinations in a number of areas critical to the ongoing management of water quality in the Occoquan watershed, situated on the southwestern periphery of the Virginia suburbs of Washington, D.C. The basin encompasses six political subdivisions, including portions of four counties, and the entire land area of two independent cities. The lab is also the site of a National Science Foundation Growing Convergence Research center on reversing inland freshwater salinization (https://salt.cee.vt.edu/).

Potomac Aquifer Recharge Monitoring Laboratory

T he PARML, Hampton, is responsible for making determinations in a number of areas critical to the ongoing management of water quality in the Potomac aquifer, situated in the Hampton Roads area of Southeast Virginia. This work is in association with managed aquifer recharge associated with the $1 billion SWIFT (Sustainable Water Initiative For Tomorrow) project.

Structures Laboratory

The Structures and Materials Research Facility is located on the campus of Virginia Tech. The laboratory provides the structural and materials faculty the necessary equipment to conduct performance evaluations of civil engineering materials, and to conduct experimental research utilizing full-scale structural components. A total of 27,000 sq. ft. of laboratory and office space is available.

Virginia Tech Transportation Institute (VTTI)

The Virginia Tech Transportation Institute (VTTI) continues to serve as Virginia Tech's largest university-level research center and is dedicated to conducting research to save lives, save time and save money in the transportation field by developing and using state-of-the-art tools, techniques, and technologies to solve transportation challenges. Its cutting-edge research is effecting significant change in public policies in the transportation domain on both the state and national levels.

W.C. English Geotechnical Research Laboratory

The W.C. English Geotechnical Research Laboratory is the most advanced of it's kind in Virginia and the mid-Altlantic region. The $1.1 million facility, located approximately one mile from campus, has spacious rooms, filled with specialized instrumentation. This laboratory boasts 6,100 square feet of research space.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

iBT: overall (90.0), subsections (each has minimum score) (20.0)

Please NOTE that at the National Capital Region campus , students are housed at the Occoquan Watershed Monitoring Laboratory (OWML), and while all graduate degree programs in CEE are available, the program area of focus within CEE is limited to the Environmental & Water Resources Engineering Program (EWR) at the NCR campus. Please see information about our graduate certificate programs in the certificate section of the Graduate Catalog. See Departmental Manual at: https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

Degree Concentrations:

Program Area Concentrations

Blacksburg Campus: Construction Engineering and Management Environmental and Water Resources Engineering Geotechnical Engineering Structural Engineering and Materials Transportation Infrastructure and Systems Engineering National Capital Region: Environmental and Water Resources Engineering - ONLY

Interdiscplinary Program Area Concentrations

Civil Infrastructure Engineering Sustainable Land Development

MEng Degree

Offered In (Blacksburg)

TOEFL

iBT: overall (90.0), subsections (each has minimum score) (20.0)

See Departmental Manual at: https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

iBT: overall (90.0), subsections (each has minimum score) (0.0)

Please NOTE that at the National Capital Region campus , students are housed at the Occoquan Watershed Monitoring Laboratory (OWML), and while all graduate degree programs in CEE are available, the program area of focus within CEE is limited to the Environmental & Water Resources Engineering Program (EWR) at the NCR campus. Please see information about our graduate certificate programs in the certificate section of the Graduate Catalog. https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdfProgram areas within CEE: Blacksburg Campus: Construction Engineering and Management Environmental and Water Resources Engineering Geotechnical Engineering Structural Engineering and Materials Transportation Infrastructure and Systems Engineering National Capital Region: Environmental and Water Resources Engineering - ONLY

Degree Concentrations:

Interdisciplinary Program Area

Civil Infrastructure Engineering

GRADUATE COURSES (CEE)

CEE 5004:

Adaptive Reuse and Redevelopment

Principles and practices for adaptive reuse and redevelopment. Value capture and creation from obsolete and underperforming infrastructure systems and facilities. Life cycle cost considerations with a focus on end of useful life decisions. Strategies for circular economic thinking and triple bottom line metrics. Risk assessment and regulatory constraints for adaptive reuse, brownfield redevelopment, and changing societal and environmental demands. Construction technologies and project

management for integrated design, modular construction, and future reuse and disassembly. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5010:

Schedule Impact Analysis

Analysis of construction scheduling principles, scheduling specifications, contract administration, construction law, construction delay claims, and of accepted methodologies for performing schedule impact analysis of delaying events. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5014:

Facility Delivery & Financing

Delivery and financing of constructed facilities with an emphasis upon civil infrastructure systems. Design of project delivery systems to encourage best value, innovation, and private sector participation. Public-private partnership strategies and factors that contribute to success or failure. Fundamentals of project feasibility, evaluation, and finance. Case studies of large-scale infrastructure projects. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5020:

Infrastructure Policy

Infrastructure policy and briefs. Policy implications for civil infrastructure. Community empowerment challenges of fair housing, climate change, urbanization, environmental justice. Communication in socio-technical infrastructure systems. Community engagement with policy makers. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5024:

Contract Administration and Claims Resolution

This course provides students with a knowledge of the different types of contracts used in civil engineering construction. Contracts are viewed as documents which assign responsibilities and allocate risks and emphasis is placed on contract administration as the first step in reducing costs and easing the burden of dispute resolution. Techniques for quantifying and resolving claims are studied.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5034:

Smart Sustainable Infrastructure

Challenges and barriers to sustainable infrastructure. Effects of a changing planet and society on infrastructure. Technology and data use for engineering. Infrastructure data interpretation. Data-driven engineering solutions. Merit and appropriateness of engineering solutions. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5044:

Construction Management Principles

Principles of construction project planning, economics, scheduling, execution and controls. Project delivery methods, procurement processes, and contract types. Valuation of project cash flows over time. Productivity and cost of equipment operations. Conceptual and detailed estimating methods. Scheduling methods for project planning, resource management, execution and control. Contemporary and professional topics. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):
Corequisite(s): null null

CEE 5060:

Built Environment Information Modeling and Processing

Introduction to technologies that enable virtual modeling and processing of the infrastructure project life cycle. Introduction to theory and application of Building and Civil Information Modeling (BIM and CIM), and their integrated practices for the architectural, engineering and construction industries. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5074:

Global Virtual Design and Construction

Fundamental aspects of modern civil engineering project execution in virtual workspaces. Participation in team-based virtual design and construction project involving students from other domestic and international universities. Design of organizational and task model, integration with design and cost models, identification of interventions that improve scheduling. Strengthened ability to work collaboratively with individuals from different countries/cultures. Both theory and practice emphasized. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5080:

Infrastructure Asset Management

Comprehensive systems approach to civil infrastructure system and strategic-level asset management with emphasis on municipal, highway, building, dam, and bridge infrastructure. Course will cover various aspects of strategic-level infrastructure asset management: systems thinking, needs assessment, information technology and GIS data management, risk and reliability engineering, multi-criteria decision making process, infrastructure sustainability and resiliency, and renewal engineering (repair, rehabilitation, and replacement). Graduate Standing required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5084:

Information Technology for Infrastructure and Environment Systems

With the acceleration of the process of global revolution in science, engineering and technology led by information technology, the human society is in a gradual transition from an industrial society into an information society. As a new productivity with the greatest potential at the present age, information technology has undergone great development. The incessant innovation in technology has also urged people to make better use of it and apply advanced information technology to their own industry. In recent years, Information Technology (IT) and Cyber Infrastructure has been transforming engineering and business practices in many sectors, resulting in efficiency gains and improved services for the client. The infrastructure industry has been slow to utilize information technology effectively and slower still to grasp the ways in which the multitude of design, calculation, specification, project management, asset management, sensor technology, database and data analysis software applications relate to each other. This course provides an overview of the range of Information Technology (IT) applications available to the civil and environmental professional throughout the life cycle of a project, from data collection and analysis through software, project management, environmental impact analysis, visualization, and infrastructure asset management. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5094:

CII Best Practices

Introduction to Construction Industry Institute (CII) Best Practices, including Front End Planning Zero Accident Techniques, Constructability, and Material Management that affects construction projects. Management influences on construction processes and critical issues. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5100:

Stormwater Treatment

Stormwater quality. Basic traps, basins, and filters. Stormwater treatment. Basic vegetative control systems. Mechanistic role of wetland. Best management practices. Monitoring, sampling, analysis, and maintenance methods. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5104:

Environmental Chemistry

Applied, environmental aspects of physical, organic, and inorganic chemistry; including applications in sanitary engineering of the phenomena of precipitation, complexation, buffering capacity, and chemical equilibria. Review of the nomenclature and properties of organic compounds.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5114:

Advanced Environmental Sustainability - A Systems Approach

Advanced quantitative methods to evaluate environmental sustainability using a systems approach. Sustainability assessment frameworks, indicators of sustainable development, green-house gas emissions, renewable energy systems, whole-system design, economic systems and input- output techniques, system dynamics models, emergence and agent-based models. Emerging sustainability topics. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5120:

Emerging Tools for Environmental Field Research

Development and use of custom measurement tools using microcontrollers, low-cost sensors, and emerging technologies. Evaluation of the capabilities, limitations, and specifications of sensors. Design and execution of real-world environmental research with low-cost environmental sensing technologies. Acquisition interpretation of analog and digital data from an environmental sensor. Troubleshooting a circuit and instrument. Design, construction, and use of a prototype instrument. Experimental design for real-world field research. Propose, evaluate and optimize a prototype instrument. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5125:

Environmental Engineering Design

5125: Design of wastewater treatment facilities for the reduction and elimination of organic and inorganic pollutants; 5126: Design of water treatment facilities for the production of potable waters from surface and groundwater systems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5126:

Environmental Engineering Design

5125: Design of wastewater treatment facilities for the reduction and elimination of organic and inorganic pollutants; 5126: Design of water treatment facilities for the production of potable waters from surface and groundwater systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5130 (ESM 5554):

Turbulence and Turbulent Flows

Nature and origin of turbulence, turbulent transport of momentum and heat, the dynamics of turbulence, statistical description of turbulence and spectral analysis. Examples of turbulent flows, boundary layers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5134:

Engineering Aspects of Water Quality

The application of biological, chemical, and physical principles of water quality to engineering problems in surface waters. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5144:

Unit Operations and Processes Laboratory

Applied science aspects of water and waste treatment; advanced research techniques in analysis and treatment of water and wastes.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): (CEE 5125 (UG) OR CEE 5126 (UG)) OR (CEE 5125 OR CEE 5126)

Corequisite(s):

CEE 5150:

Atmospheric Chemistry

Fundamental physical and chemical systems in the atmosphere. Chemical reactions between atmospheric constituents. Chemical processes that form, transform, and remove pollutants in the atmosphere. Structure and composition of the atmosphere. Oxidation of natural and anthropogenic emissions. Aqueous and organic aerosol chemistry. Interactions between gases and particles. Human influence on atmospheric processes. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5154:

Air Pollution Transport and Chemistry

Air pollutant emissions, transformation, transport, and fate. Global climate change, ozone chemistry, air pollution modeling, particle dynamics, and air quality management. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5164:

Environmental Biotechnology

Introduction to environmental biotechnologies for wastewater treatment. Fundamentals of environmental microbiology. Engineering principles for applying biotechnology to address environmental pollution control. Advanced biotechnologies, membrane bioreactors, and algal bioreactors. Sustainable environmental remediation and protection. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5174:

Applied Analytics for Environmental Science and Civil Engineering

Programing in multiple languages. Control structures for curating and manipulating data, user defined functions, implementation of data analysis packages, generation of publication quality graphics. Probability distributions, parametric and nonparametric bootstrapping. Nonparametric confidence bounds and prediction intervals for simple, multiple and generalized linear regression. Multivariate techniques including cluster analysis, classification and regression trees, principal component analysis, correspondence analysis, redundancy analysis, canonical correspondence analysis. Application to environmental science and engineering datasets. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5184:

Techniques for Environmental Analysis

An introductory course on techniques commonly utilized for analysis of environmental samples. Course will discuss gas and liquid chromatrography, mass spectrometry, and atomic absorption spectroscopy, focusing on analysis of complex environmental samples. Practical techniques and applications are emphasized, but sufficient theory is introduced to provide students with an understanding of the principles involved.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5194:

Environmental Engineering Microbiology

Roles of microorganisms in wastewater treatment, anaerobic digestion of municipal sludges, stream self-purification, and degradation of water quality in drinking-water systems. Disinfection of wastewater and drinking water to remove viruses, bacteria, and protozoa that cause waterborne disease.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5204:

Gis Applications in Civil Engineering

Examination of data structures used in geographic information systems. Map projections and coordinate systems used in mapping. Database creation, maintenance, and integrity. Applications of GIS methods for solving civil engineering problems in land management and related areas.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5244 (BSE 5244):

Advanced GIS in Hydrologic Analysis

Advanced GIS course focusing on raster analysis with particular application to the issues associated with hydrologic analysis. Application and evaluation of algorithms for terrain analysis, watershed characterization, and hydrologic analysis and modeling as implemented in GIS. Digital elevation data sources and error assessment. Approaches to GIS/model integration and application. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5254:

Municipal Engineering

Field of municipal engineering. Infrastructure, capital projects, financing, sustainability, disaster planning and response, and municipal plan review techniques. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5264:

Sustainable Land Development

Contemporary techniques for developing land while maintaining a focus on long-term sustainability. Smart location and linkage, neighborhood pattern and design, conceptual design, stormwater strategies, green buildings and energy. Development standards such as Leadership in Energy & Environmental Design (LEED) and Envision. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5264G:

Advanced Air resources Engineering

Effects, regulation, sources, and control of air pollution. Application of engineering calculations and models to estimate emissions, predict pollutant concentrations, and design pollution control equipment.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5274:

Land Development Design Projects

Analysis of land development projects. Land development industry,government policies and regulations, legal topics, engineering design, and construction practices. Site feasibility analysis, site planning, environmental compliance, conceptual layout, and ADA compliance. Design of major infrastructure systems. Use of computer aided drafting and design software. Design project. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5304:

Environmental Fluid Mechanics

The first part of the course will be devoted to basic concepts and equations of fluid motion. The remainder of the course will be concerned with the theory of incompressible viscous and inviscid fluids. Selected applications will be drawn from environmental and water resources topics. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5314:

River Mechanics and Sediment Transport

Sediment properties; critical stress; bed-form regimes in alluvial streams; depth-discharge relations for rivers; bed load and suspended load movement; river stability; flow in bends; river training. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5334:

Analysis of Water Resources Systems

Introduction to quantitative hydrology. Diverse computational aspects within watersheds. Methods and models used to examine components of hydrologic cycle. Risk analysis and statistical probability in hydrology. Comprehensive models for watershed management and urban hydrology. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5344:

Surface Water-Groundwater Interaction

Interaction (exchange) of surface water with groundwater at watershed, reach, sediment-patch scales including bidirectional hyporheic flows. Focus on streams and rivers, consideration of lakes. Steady and unsteady exchange hydraulics including laminar and turbulent flows. Exchange benefits and engineering goals including heat transfer, nutrient processing, and contaminant attenuation. Engineering applications including conjuctive use of surface water and groundwater resources and impact of groundwater pumping on rivers. Field methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5354:

Numerical Modeling of Groundwater

Theory and practice of numerical techniques are developed and applied to fluid flow and transport in ground-water flow systems. Governing equations are formulated using FD and FE techniques with appropriate BCs and ICs. Additional topics include: model conceptualization and grid design in multidimensional systems; practical applications of numerical models including calibration, validation, and prediction; concepts and techniques of advective transport using particle tracking and dispersive transport. Introduction to MODFLOW, MODPATH, MT3D, and others. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5374:

Dynamics Groundwater

The theory of dynamics of fluids in porous media; fluid and matrix properties; transport equations; boundary and initial value problems; flow of immiscible fluids; dispersion. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5384:

Advanced Open Channel Flow

Advanced treatment of the mechanics of open channel flow, including uniform flow, gradually varied flow, channel transitions, and unsteady flow. Independent research project. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5390:

Advanced Urban Water Sustainability

Climate change and the supply of freshwater. Coupled socio-hydrologic feedback loops (systems dynamics models) and implications for water systems resilience. Urban water transitions theory and the evolution of water systems through time. Water productivity. Stormwater capture and reuse, green stormwater infrastructure, and ecosystem services. Decentralized water and wastewater treatment systems. Emphasis is placed on the social (equity), environmental, and technological context in which urban water systems operate. Advanced statistical computing is used to quantitatively explore urban water systems challenges. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5400:

Design of Prestressed Concrete

Principles of prestressing applied to single and multiple span concrete beams, beams with composite slabs, and two-way slabs. Design of individual elements of prestressed concrete for allowable stresses, flexural strength and shear that satisfy industry standards. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5410:

Intermediate Reinforced Concrete Structures

Behavior and design of reinforced concrete structures subjected to gravity and lateral loads. Moment-curvature relationships for reinforced concrete beams with and without confinement. Collapse mechanisms and redistribution in continuous members. Development length, slender columns, two-way floor systems, and combined shear and torsion. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5414:

Finite Element Analysis of Structures

Formulation of the finite element method and application to skeletal, plate, and shell structures. Study of mesh layout and refinement, convergence characteristics, and solution accuracy. Tests of element quality. Use of commercial finite element codes such as ABAQUS.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5420:

Computer Methods of Structural Analysis

Formulation of the matrix displacement method in a form suitable for program development. Application to trusses, continuous beams, grids, and frames. Incorporation of special features such as constraints, rigid ends, internal releases, and support settlements. Initiation and modification of existing programs on the personal computer. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5430:

Intermediate Design of Steel Buildings

Design of major components in steel-framed buildings, including composite beams and slabs, beam-columns, and moment connections. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5440:

Instrumentation and Signal Processing for Civil Engineering Applications

Fundamental operating principles and implementation guidelines for instrumentation in civil engineering. Measurements for strain and load, acceleration, temperature, pressure. Data acquisition and signal processing concepts, sampling, filtering, and frequency domain analysis. Statistics, uncertainty analysis, and experimental methods applied to sensor measurements. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5444:

Stability of Structures

Methods of static structural stability analysis and their applications. Buckling of columns and frames. Energy method and approximate solutions. Elastic and inelastic behavior. Torsional and lateral buckling. Use of stability as structural design criterion. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5450:

Forensic Struct Engineering

Cultural and technical basis for concepts of risk and failure, formal approaches to failure investigation, origins of natural and man-made disasters, the role of building codes, standard of care, ethical standards, community resiliency, and legal issues as related to forensic structural engineering. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5454:

Blast Resistant Design of Structures

Explosion sources and blast waves. Computation of blast load parameters. Single degree of freedom dynamic analysis of blast loaded components. Material behavior at high strain rates. Protective design and detailing of concrete and steel structures and non-structural components. Retrofitting and hardening of existing structures. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5464:

Structural Dynamics and Earthquake Engineering

Earthquake-induced vibration of single- and multi-degree-of-freedom systems; application to frames and to shear and torsional buildings; response spectrum analysis; building codes; static and dynamic lateral force procedures; seismic resistance of steel and concrete building frames. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

CEE 5470:

Structural Design for Seismic Load Effects

Analysis and design of steel and reinforced concrete structures for

seismic load effects. Fundamental principles of earthquake engineering, as rooted in seismic hazard analysis, inelastic behavior, and dynamic response. Application of these principles to the design and detailing of reinforced concrete and structural steel buildings. Building code requirements for seismic loading and seismic resistant design.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CEE 5464
Corequisite(s):

CEE 5474:

Advanced Reinforced Concrete Design

Limit design concepts, yield-line methods, seismic considerations, and other advanced topics related to design of reinforced concrete structures. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5480:

Steel Bridge Design

Design and analysis of primary bridge components including concrete decks, steel plate girders, and bracing members. Moving loads, and load combinations specific to bridges using current design codes. Fatigue and fracture limit states from repetitive vehicular loads. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5484:

Concrete Microstructure

Modern cement production. Composition and hydration mechanisms of concrete and other cementitious composites. Micro- and nanostructural development of fresh and hardened concrete. Effects of chemical admixtures, mineral fillers, and supplementary cementitious materials. Application of advanced characterization techniques to cement and concrete microstructure. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5490:

Structural Mechanics

Mechanics of civil materials and structural components. Fundamentals of elasticity. Bending of beams, beam-columns, and thin plates. Energy methods for boundary value problems. Stability conditions. Failure criteria, introductory fracture mechanics, and plasticity theories. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5494:

Reliability Methods in Structures and Mechanics

Theory of structural reliability; reliability based designs, safety index, linear and nonlinear design equations, load and resistance factors, Level I, II and III formats, code formulations; systems reliability, bounds on reliability.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5500:

Numerical Methods in Geotechnics

Numerical modeling of geotechnical systems. Numerical methods in geotechnics. Finite element method, formulation of boundary value problems, principles of coupled hydromechanical analysis. Structure and use of finite element software.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5504:

Risk Analysis Geotechnical Engineering

Methods for risk analysis of complex systems. Basic concepts of probability and reliability applied to geotechnical engineering problems. Geostatistics concepts. Probabilistic seismic hazard analysis and performance based design. Computational tools and simulation methods. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5510:

Thermal and Energy Geotechnics

Thermal properties of soils. Laboratory and in-situ thermal tests. Temperature effects on soil behavior. Design of thermo-active foundations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5514, CEE 5544

Corequisite(s):

CEE 5514:

Soil Behavior

Behavior of soil examined from a fundamental soil perspective. Review of methods of testing to define response; rationale for choosing shear strength and deformation parameters for soils for design applications. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5524:

Advanced Soil Testing for Engineering Purposes

Methods of testing and analysis of soil for engineering properties including compressibility; strength in triaxial, simple, and direct shear; permeability; and stability. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5534:

Foundation Engineering I

Behavior and design of retaining walls and shallow foundations. Earth pressures, bearing capacity, and settlement. Stress distribution and consolidation theories. Settlement of shallow foundations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5544:

Foundation Engineering II

Behavior and design of anchored bulkheads, excavation bracing, driven piles, drilled piers and buried structures. Effects of pile driving. Response of deep foundations to vertical and horizontal loads.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5534 (UG) OR CEE 5534

Corequisite(s):

CEE 5554:

Soil and Site Improvement

Methods of soil and site improvement including design techniques for dewatering systems, grouting, reinforced earth, in-situ densification, stone columns, slurry trenches, and the use of geotextiles. Construction techniques for each system are described. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5564:

Seepage and Earth Structures

Soil permeability and seepage through soils. Embankment design. Compaction, earth pressures and pressures in embankments. Slope stability analysis. Settlements and horizontal movements in embankments. Landslide stabilization.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5514 (UG) OR CEE 5514

Corequisite(s):

CEE 5584:

Geotechnical Aspects of Earthquake Engineering

Causative mechanisms of earthquake, earthquake magnitudes, ground motion, effect of local soil conditions on motions. Response of soils to seismic loading, liquefaction phenomena and analysis of pore pressure development, laboratory and in-situ testing for seismic loading. Analysis and design of slopes, embankments, foundations, and earth retaining structures for seismic loading. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5594:

Geological Engineering

Mechanical and hydraulic properties of rock masses; analysis and design of rock foundations, slopes, tunnels, and other forms of civil infrastructure; rock reinforcement. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5600:

Civil Infrastructure Systems Analysis

Systems analysis, modeling infrastructure systems by mathematical programming, measuring infrastructure systems performances, probabilistic analysis of infrastructure systems, multiple attribute decision making in infrastructure systems. Pre: Graduate standing in engineering is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5604:

Traffic Characteristics and Flow

Driver, vehicle, and roadway characteristics; stochastic modeling of traffic processes including queueing theory, headway distributions, and gap acceptance; stream flow characteristics including car-following and multilane traffic models, roadway capacity and bottleneck analysis, network operations, and fuel consumption models. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5610 (ESM 5044G):

Advanced Mechanics of Composite Materials

Introduction to the deformation, stress, and strength analysis of continuous-fiber-polymer-matrix laminated composites. Fabrication, micromechanics of stiffness and expansional coefficients, classical lamination theory. Environmentally induced stresses. Computerized implementation and design. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5614:

Analysis of Air Transportation Systems

Planning, design and operation of aviation systems with computer aided design tools and computer simulation models. Airline airport operations and practices and their effect in airport planning and design. Air cargo facilities planning and modeling. State-of-the-art computer simulation models used in aviation environmental planning and airspace modeling. Graduate standing in CE required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5624:

Transportation and Land Use

Interaction between transportation and land use variables, including modeling requirements, impacts, and data needs within the context of good community planning and economic development; elements of transportation and land use that shape the quality of life in urban areas. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5634:

Analysis and Planning of Mass Transit Systems

An overview of mass transit systems; transit system planning including demand and cost analysis and evaluation; transit system design including route design, scheduling, and fare policy; transit networks and marketing; para transit systems; future trends in mass transit. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5640:

Highway Transportation Safety

Identification of highway safety problems and development of solutions. User characteristics and expectations, road audits, roadside hardware systems, safety enhancing treatments, standard traffic control devices, real-time information and control systems, work zone and railroad crossing treatments, older driver design concepts, traffic calming, designs for pedestrians and bikes, delineation and lighting principles, and advanced 3D/4D design concepts. Group and individual analyses of problems. Pre: Graduate standing in engineering is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5650:

Freight Operations & Planning

Introduction to the operation of modal and intermodal freight facilities and operation. Types of freight movement and handling equipment, freight planning methods, and research. Freight as a multi-modal transportation system. Role of privately owned and operated freight movement on public sector transportation operations and decision making. Communication of impacts of freight movement. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5654:

Critical Issues in Transportation

Technological, societal, economic, political, environmental, health, and energy effects on planning, design, operation, and management of the transportation system. Modeling of complex interactions and causal relationships among current issues. Principles of optimization for design and operation of the five basic elements of transportation (vehicles, networks, terminals, controls, and system administration). Problem definition, objectives identification, model development, alternatives generation and evaluation, and reasoning process for transportation investment. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5664:

Intercity Transportation

Intercity transportation, including trucking, railroads, and aviation industries, as a vital part of the economy. Operation and logistic rules that govern the flow of shipments and dictate costs and freight rates under various regulatory policies and market environments. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 3604

Corequisite(s):

CEE 5694:

Traffic Signal System Operation and Control

Traffic signal system control, with emphasis in arterial operation. Signal system design and operations, traffic simulation techniques, advanced traffic control strategies, and incorporation of surface street systems into Intelligent Transportation Systems (ITS). Hands on experience in signal system software and hardware. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5704 (PHS 5704):

Drinking Water & Health

Drinking water contamination and associated health outcomes. Programs to improve safe water access. Viral, bacterial, protozoal, and helminthic pathogens. Heavy metals, pesticides, and other contaminants. Drinking water treatment and supply in rural areas. Study designs for health outcome assessment. Field-based intervention trials. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

CEE 5714:

Surface Water Quality Modeling

Use, analysis, and development of water quality models for lakes, rivers, and estuaries. Emphasis on model calibration, verification, and post-audit analysis. Lab portion will develop and apply a eutrophication model for an estuary using existing data.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5724:

Environmental Monitoring and Sampling

Experimental design and sampling techniques for environmental analysis, including environmental monitoring techniques and statistical principles for planning monitoring locations and frequencies at environmental sites such as landfills, rivers, lakes, and the atmosphere. Development of monitoring strategy; examination of sampling techniques for various sample types.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): CEE 5104

CEE 5734:

Urban Hydrology and Stormwater Management

Development of methods and numerical models for computing surface runoff from developing watersheds; hydraulics of combined sewer systems; urban non-point source pollutant load calculations and best-management practices; control strategies for regional stormwater management; detention basin design for control of urban floods and non-point source pollutants. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5744:

Topics in Structural Steel Design

Calculation of stresses in steel members. Overall-local buckling interaction. Design of singly symmetrical and unsymmetrical columns and topics on flexural design, design of plate girders, bracing design, and design of framing connections. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5754:

Pavement and Bridge Infrastructure Management Systems

Management concepts used in civil infrastructure; planning, design, construction, maintenance, and rehabilitation of bridge and highway systems. Prioritization, optimization, and decision-making techniques. Life-cycle-cost prediction. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5764:

Asphalt Technology

Origin, types and properties of bituminous materials and their use in civil engineering. Asphalt rheology. Theory behind technological processes and procedures for hot-mix asphalt including design philosophy, performance, and durability. Modern construction with bituminous materials; special mixtures, recycling, and additives. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5784:

Special Topics in Portland Cement Concrete

Advanced tools and approaches for supporting more sustainable transportation infrastructure investment decisions by balancing technical, economic, environmental, and social objectives. Selection of sustainable materials, systems and management approaches. Mitigation and adaptation to climate change. Cost and environmental life-cycle assessment methods and tools pertaining to transportation systems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5794:

Environmental Engineering Principles

Examines the basic physical, chemical, and microbiological principles that provide the foundation for environmental engineering. Illustrates how these principles are applied to solve a wide range of environmental problems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): CEE 5104

CEE 5804:

Engineering Ethics and the Public

Moral obligations of engineers and scientists toward the publics they serve; responsible conduct of research; responsible conduct of practice; the responsibilities and risks of witnessing wrongdoing; the value of non-expert knowledge claims and the importance of listening to public stakeholders. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5814:

Structure-Sediment Interaction

Scour processes at structure foundations in the coastal zone. Erosion and undermining at port walls, pipelines, piers, jetties, breakwaters, artificial reefs. Foundations and moorings for nearshore renewable energy devices. Sediment remobilization and liquefaction as a consequence of cyclic loadings and extreme events. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5834:

Asphalt & Pavement Modeling

Characterization of asphaltic concrete microstructure. Relations to macroscopic properties. Pavement performance modeling. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5844:

Ocean and Coastal Wave Mechanics

Linear wave theory including boundary value problems, wave transformation in shallow waters, long waves, and engineering properties of waves. Introduction to nonlinear wave theories. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5854G:

Advanced Coastal Engineering

Basic wave mechanics principles, surf-zone processes, littoral and sediment processes, shoreline features, astronomical tides, coastal hazards, and functional design of coastal structures. Field trips. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5864:

Coastal and Estuarine Morphodynamics

Sediment transport in marine environments, shoreline change, bedform evolution and morphodynamics, tidal inlet morphodynamics, barrier island processes, storm erosion, delta development, beach dynamics. Evolution of estuarine waterways and wetland systems. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5874:

Coastal and Marine Geotechnics

Geotechnical aspects of coastal and marine engineering. The coastal zone as a working environment. Geotechnical properties of beach and seafloor sediments, methods and processes for subaqueous and coastal site investigations, complementary techniques for investigation. In-situ survey strategies, planning and management. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5884:

Legal Aspects of Civil, Construction and Environmental Engineering

Analysis of relevant federal and state law (commercial law, contracts law, environmental law) in application to the design and construction of civil and/or environmental engineering projects, as well as water and wastewater treatment and management. Professional liability, risk management and environmental regulatory compliance issues. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CEE 5944:

Seminar

Review and discussion of current literature, research, and consulting activities by student, faculty, and guest speakers.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, Online Lecture
Instruction Type(s): Independent Study, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

CEE 6104:

Advanced Environmental Chemistry

Advanced theories and practices in environmental engineering with special emphasis on inorganic aspects of water chemistry; application of water chemistry fundamentals for the description of aquatic systems. Pre: Graduate standing.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 6114:

Advanced Topics in Air Quality Engineering

Review and critique of current research. Emissions, transport, transformation, and fate of gases and particles in the atmosphere. May be repeated with different topic content for a maximum of 3 credits. Pre: Graduate standing.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 6404:

Dynamics of Structures

Formulation of equations of motion by the finite element method. Solution by mode superposition and direct methods. Earthquake analysis and nonlinear analysis. Application to skeletal and plate structures. Development of computer programs and use of commercial programs. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (CEE 5414 (UG), ESM 4074 (UG)) OR (CEE 5414, ESM 4074)
Corequisite(s):

CEE 6414:

Nonlinear Finite Element Analysis for Solids and Stuctures

Nonlinearities encountered in solid and structural mechanics. Finite element formulation of nonlinear truss and beam problems. Nonlinear solid mechanics and plasticity theory. Algorithmic implementation of elasto-plastic constitutive models. Implicit and explicit solution procedures for finite element analysis of nonlinear static and dynamic problems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CEE 5414
Corequisite(s):

CEE 6424:

Advanced Prestressed Concrete

Behavior and design of prestressed slabs, bridges, and precast building systems. Continuous prestressing; load-balancing method for slabs; torsion and shear; connections for precast members; partial prestressing. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 6434:

Advanced Steel Design

Advanced topics of current interest in structural steel design research as given by recent publications and informal reports. In-depth study of selected projects. May be repeated. 12 credits of 5000-level courses in structures or solid mechanics required. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 6504:

Introduction to Constitutive Modeling of Soil

Constitutive Laws for Soils, nonlinear elastic and plastic models. Consolidation, layered systems, sand drains, approximate three-dimensional theories, and Biots poro-elastic formulation. Plastic equilibrium in soils Sokolovskis method of characteristics, applications to earth pressure, bearing capacity, and slope stability problems. Analysis of machine foundation problems, elastic waves through soils, dynamic properties of soils.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CEE 5514 (UG) OR CEE 5514
Corequisite(s):

CEE 6514:

Dynamics of Soils and Foundations

Principles of the dynamics of soils and foundations. Seismic waves. Non-linear dynamic soil behavior and vibrations. Dynamic-soil-structure interaction. Impedance functions and machine foundation design.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CEE 5584
Corequisite(s):

CEE 6844:

Current Topics in Coastal Eng

Contemporary challenges and research questions in coastal engineering. Review and critique of contemporary coastal engineering literature. May be repeated with different topic content for a maximum of 6 credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CEE 5854G
Corequisite(s):

CEE 6984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

COMMUNICATION

John Tedesco, Head

Professors: Carlos Evia Puerto; Jim Kuypers; Marcus Myers; John Tedesco;
Associate Professors: Jennifer Burleson; Rachel Holloway; Adrienne Holz; Michael Horning; Nneka Logan; Natalia Mielczarek; Stephanie Smith; Brandi Watkins;
Assistant Professors: Megan Duncan; Chelsea Woods;
Associate Professor of Practice: Charmayne Smalls Brown;
Collegiate Assistant Professors: Hannah Shinault;

Graduate Contact: mcmyers@vt.edu
School of Communication: https://liberalarts.vt.edu/departments-and-schools/department-of-communication/academic-programs/master-of-arts-in-communication.html
Graduate Facebook: https://www.facebook.com/VTCommunication

Program introduction The M.A. in Communication degree program offers two majors (1) Reputation Management and (2) Communication. The M.A. in Reputation Management focuses on public relations management in a variety of sectors including corporate, nonprofit, and government sectors. This degree is designed for students interested in advanced studies on how to improve public perceptions of organizations and enhance the goodwill asset on the company balance sheet. Students who complete the Reputation Management major earn a graduate professional credential that prepares them for broader management responsibilities and enhances their career advancement. Reputation Management is delivered on campus in Blacksburg and in Falls Church, Virginia, using a bimodal delivery of courses. The M.A. in Communication involves advanced study in strategic communication and society, media, and technology research from a variety of theoretical and methodological perspectives. The program introduces students to public and mass communication for application to academic and professional settings. Students engage in reviewing and discussing research and criticism while collecting and interpreting original research data. The M.A. in Communication is a residential program located on campus in Blacksburg. Both the M.A. in Communication and Reputation Management have opportunities for funded graduate assistantships. These assistantships provide a GTA salary and payment toward tuition (tuition remission), but are only available for the residential option. Degree Requirements Coursework for the Reputation Management major requires t 9 credit hours of core subjects (Communication Theory, Quantitative Research in Communication, and Qualitative Research in Communication), 15 credit hours in specified public relations courses, 9 credit hours of electives in suggested business courses, and 3 hours in professional project or report (non-thesis) credit. Successful completion of the M.A. program’s ethics requirement is part of the progress toward degree. All graduate students receiving the M.A. in Communication degree must complete 36 credit hours. Required coursework for students in the Communication major includes 9 credit hours of core subjects (Communication Theory, Quantitative Research in Communication, and Qualitative Research in Communication), 15 credit hours of major-specific coursework, at least 6 credits hours of electives, and 6 hours of thesis credit. The thesis includes an oral defense administered by the student’s advisory committee and a public presentation of thesis findings. Major Descriptions Students in the Reputation Management major apply communication and public relations theories to business problems in real-world situations. These students, public relations practitioners with five or more years of experience, complete professional projects or reports. These allow students to demonstrate that they can put what they have learned in coursework into practice in a variety of business contexts. The program boasts a nearly 100% placement rate for Communication majors at top Ph.D. departments for graduates interested in pursuing doctoral study. Those planning a professional career typically are employed within four months of graduation. Deadline for Fall admission and funding is February 1st. Second-round applications are accepted until May 31st. The program does not typically accept spring admissions for full-time students; part time students should consult with the graduate director Dr. Cayce Myers, mcmyers@vt.edu. Detailed information about the program’s goals, funding opportunities, faculty, and application procedure, may be found by visiting the Virginia Tech Communication M.A. webpage.

SPECIAL FACILITIES

The School of Communication’s research facilities include a range of spaces and equipment to facilitate social and behavioral research employing multiple methods.

The Digital Media Research Facility

The Digital Media Research Facility is housed in the basement of Shanks Hall and includes multiple research laboratory facilities, including the Virginia Tech Gaming and Media Effects Research Laboratory (VT G.A.M.E.R. Lab) and other laboratories in development. Research equipment contained in the labs includes psychophysiological measurement equipment, Perception Analyzer real-time-response equipment, digital gaming and virtual reality hardware, and software for media production, data analysis, and data visualization. Spaces include multi-purpose rooms, laboratory experiment rooms, and an observation room with a one-way mirror.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg, National Capital Region)

TOEFL
GRE

General: Verbal (150.0), Quantitative (152.0), Analytical (4.0)

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funding opportunities, faculty, and application procedure, may be found by visiting the Virginia Tech Communication M.A. webpage.

GRADUATE COURSES (COMM)

COMM 5014:

Communication Theory

A broad survey of contemporary theories and processes of interpersonal, public, and mediated human communication. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): COMM 5024

COMM 5024:

Quantitative Methods in Communication

Theoretical traditions and assumptions of quantitative inquiry in the communication discipline. Hypothesis generation; research design, data collection and analysis. Ethical issues, style conventions, and standards for establishing reliability and validity. Open science practices. Distinctive contributions of quantitative research to communication theory and practice. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

COMM 5034:

Teaching Practicum

Training in teaching the basic communication course at the university level. Emphasis on the theory and practice of teaching public speaking, prepared related materials and class sessions, and responding to student assignments. Graduate standing requires. May be repeated for up to 3 hours.

Credit Hour(s): 1 TO 2

Lecture Hour(s): 1 TO 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

COMM 5044:

Prospectus Practicum

Applied, advanced work in prospectus development.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): COMM 5024

Corequisite(s):

COMM 5054:

Qualitative Methods in Communication

Theoretical traditions and assumptions of qualitative inquiry in the communication discipline. Methods of data collection, interpretation, analysis, and presentation. Ethical issues, style conventions, and standards for establishing interpretive reliability and validity. Distinctive contributions of qualitative research to communication theory and practice. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

COMM 5894:

Final Examination

For non-thesis candidates who are required to register for their final examination and have completed their program of study. Not to be included in minimum 36 hours required for degree.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

COMM 5904:

Project and Report

For students pursuing a non-thesis degree. Projects may involve guided research/scholarship or an internship.

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

COMM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

COMM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

COMM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

COMPUTATIONAL TISSUE ENGINEERING

Padmavathy Rajagopalan, Program Director

Professors: Padmavathy Rajagopalan;

Chemical Engineering: Padmavathy Rajagopalan;

Dr. Padma Rajagopalan: padmar@vt.edu

Graduate Site: http://cte.cs.vt.edu/about-cte

Graduate Site: https://cte.cs.vt.edu/

The goal of this interdisciplinary graduate education program is to define the field of Computational Tissue Engineering (CTE), wherein seamlessly intertwined computational and experimental models will drive the next generation of advances in tissue engineering. Our vision is that predictive computational models will drive novel experimental analyses of engineered tissues, while the demands of tissue engineering will inspire novel analysis frameworks in computational science. We will train students at the confluence of tissue engineering, molecular and cell biology, and computational science. Our vision is that trainees will emerge as the leaders of the trans-disciplinary field of “Computational Tissue Engineering”. They will be equipped to lead and develop this new field, have the training to span traditional disciplinary boundaries, and to converse in the languages of tissue engineering, molecular and cellular biology, and computational science with ease. These students will be well-equipped to address the current challenges faced by each of these fields.

SPECIAL FACILITIES

This is an interdisciplinary program and shares facilities among departments across campus. Colleges and Departments:College of Engineering Chemical Engineering Computer Science Biomedical Engineering and MechanicsIndustrial Systems EngineeringMechanical Engineering College of Science Biological Sciences, Statistics College of Agriculture and Life Sciences BiochemistryCollege of Veterinary Medicine Biomedical Sciences and PathobiologyCollege of Liberal Arts and Human Sciences Science and Technology in SocietyBiocomplexity InstituteFor more information please contact: Professor Padma Rajagopalan, Program Director, padmar at vt dot edu

Facilities

This is an interdisciplinary program and shares facilities among departments across campus. Colleges and Departments: College of Engineering Chemical Engineering Computer Science Biomedical Engineering and Applied Mechanics Industrial Systems Engineering Mechanical Engineering College of Science Biological Sciences Statistics College of Agriculture and Life Sciences BiochemistryCollege of Veterinary Medicine Biomedical Sciences and PathobiologyCollege of Liberal Arts and Human Sciences Science and Technology in SocietyBiocomplexity Institute

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

CTE students will obtain their Ph.D. degrees from a parent department or program, from among the several that CTE faculty are affiliated with. When you apply to the Graduate School at Virginia Tech, please be sure to specify from which department you seek to obtain a Ph.D. Typically, a CTE student identifies a CTE faculty member during the admissions and recruitment process. After the student joins Virginia Tech, she can consult the advisor and identify another faculty member to serve as a co-advisor. We strongly encourage students to work with advisors spanning at least two of the three areas at the core of CTE (tissue engineering, computational science, and systems biology) and to include committee members in the third area.

COMPUTER ENGINEERING

Luke Lester, Head

Emeriti Faculty: Peter Athanas; Aloysius Beex; Robert Broadwater; Gary Brown; C Clauer; William Davis; Gregory Earle; Louis Guido; Mark Jones; Fred Lee; Cameron Patterson; Arun Phadke; Krishnan Ramu; Warren Stutzman;

Professors: Amos Abbott; Masoud Agah; Paul Ampadu; Scott Bailey; Joseph Baker; Dushan Boroyevich; Richard Buehrer; Rolando Burgos; Virgilio Centeno; Harpreet Singh Dhillon; Dong Ha; Yiwei Hou; Michael Hsiao; Jih Lai; Luke Lester; Chen-Ching Liu; Thomas Martin; Scott Midkiff; Lamine Mili; Khai Ngo; Mariusz Orlowski; Paul Plassmann; Ting Chung Poon; Saifur Rahman; Binoy Ravindran; Jeffrey Reed; John Ruohoniemi; Walid Saad; Ahmad Safaai-Jazi; Timothy Sands; Wayne Scales; Leonard Smith; Angelos Stavrou; Daniel Stilwell; Joseph Tront; Yue Wang; Anbo Wang; Yong Xu; Jianhua Xuan; Yaling Yang; Guoqiang Yu; Richard Zhang;

Associate Professors: William Baumann; Thidapat Chantem; Jaime De La Reelopez; Steven Ellingson; Ryan Gerdes; Mantu Hudait; Xiaoting Jia; Vasileios Kekatos; Qiang Li; Lingjia Liu; Majid Manteghi; Ali Mehrizi-Sani; Leyla Nazhandali; JoAnn Paul; Ryan Williams; Chris Wyatt; Yang Yi; Haibo Zeng; Wei Zhou; Yizheng Zhu;

Assistant Professors: Jordan Budhu; Christina Dimarino; Thinh Doan; Dong Dong; Ruoxi Jia; Ming Jin; Zin Lin; Elena Lind; Chang Woo Min; Linbo Shao; Wenjie Xiong; Yuhao Zhang;

Grant A. Dove Professor: Yue Wang;

Virginia Microelectronics Consortium Professor of Engineering: Masoud Agah;

Bradley Distinguished Professor: Yiwei Hou;

James S. Tucker Professor: Jih Lai;

Willis Worcester Professor: Jeffrey Reed;

University Distinguished Professor: Dushan Boroyevich; Fred Lee; Arun Phadke;

Clayton Ayre Professor: Anbo Wang;

Joseph R. Loring Professor: Saifur Rahman;

Bradley Faculty Fellow of Education: Thomas Martin;

J. Byron Maupin Professor of Engineering: Wayne Scales;

Elizabeth and James Turner Faculty Fellow: Harpreet Singh Dhillon;

Roanoke Electric Steel Professorship in Engineering: Luke Lester;

American Electric Power: Chen-Ching Liu;

Collegiate Assistant Professors: Almuatazbellah Boker; Kendall Giles; Sook Ha; Mary Lanzerotti; Ravi Raghunathan;

Clinical Assistant Professors: Arthur Ball;

Collegiate Associate Professors: Kristie Cooper; Jeffrey Ransbottom; Alkan Soysal; Nektaria Tryfona;

Collegiate Professors: Scott Dunning; Creed Jones; Timothy Talty;

Hugh P. and Ethel C. Kelly Professor: Richard Zhang;

Graduate Admissions: vt.ece.gradadm@vt.edu

Graduate Advising: vlaura@vt.edu

Student Handbook: https://ece.vt.edu/grad/manual.html

The Harry Lynde Bradley Department of Electrical and Computer Engineering offers graduate degree programs leading to the Master of Engineering (M.Eng.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) in electrical engineering and computer engineering. The M.S. and Ph.D. degree programs are offered through the Blacksburg campus as well as extended campus consortia (National Capital Region, Northern Virginia Center, Falls Church, Virginia; Central; Hampton Roads; Western, and VT-MENA through Alexandria and Cairo, Egypt). The M.Eng. degree is offered at the National Capital Region (NCR) and Virtual campuses.The ECE Department offers both an M.S. Thesis and an M.S. Non-Thesis degree. For the M.S. Thesis degree, each plan of study is developed by the student in consultation with his or her faculty advisor satisfying the M.S. Thesis degree requirements and the defense of a thesis. The M.S. Non-Thesis degree is a coursework-based master's degree. The M.Eng. degree is a professionally-oriented degrees that offers graduate students a strong academic foundation in core ECE technological areas with a culminating, project-based learning experience.The Ph.D. is the highest academic degree awarded by the university and is conferred upon students who demonstrate outstanding original scholarship during advanced study. It signifies that the student can conduct independent research and has both a broad basic knowledge of all areas of the field and a comprehensive knowledge of one area. Students applying for the Ph.D. program typically have a master's degree from an accredited college or university in EE, CPE, or a related field.A direct-Ph.D. option is available for students without an earned master's degree. These students will earn an M.S. Thesis, or an M.S. Non-Thesis, degree in addition to the Ph.D. The Bradley Department of Electrical and Computer Engineering's current enrollment is approximately 610 students. Out of the enrolled students, approximately 95% of our full-time Ph.D. students are funded and approximately 85% of our full-time master's student are funded. Most funding is available in one of three ways: Graduate Teaching Assistantships (GTAs) – awarded by the ECE department; Graduate Research Assistantships (GRAs) – awarded by individual ECE faculty; or Fellowships – awarded by the department to the top applicants to the program. Of the fellowships awarded by the department, the Bradley Graduate Fellowship is the highest honor bestowed on ECE Ph.D. students and is restricted to U.S. citizens only.

SPECIAL FACILITIES

Well-equipped research facilities, labs, and centers are available within the different research areas. For more information, click here.

DEGREES OFFERED

MEng Degree

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (90.0)

IELTS

General: Band (7.0)

The M.Eng. degree requires 30 credit hours, and the following specific requirements must be met: 27 credit hours of coursework (subject to M.Eng. course restrictions) and project and report consisting of either: 21 credit hours of senior and graduate-level coursework and 6 credit hours of Graduate Design Project and Report, ECE 5805 and 5806; or 24 credit hours of senior and graduate-level coursework and 3 credit hours of Project and Report, ECE 5904; 2 credit hours of Seminar, ECE 5944; 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; and A final examination consisting of a presentation of the project and report must be passed. The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

MS Degree

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (96.0)

GRE

General Test: Verbal (153.0), Quantitative (157.0), Writing (4.5)

IELTS

General: Band (7.5)

The ECE Department offers both an M.S. Thesis and an M.S. Non-Thesis degree. The degree requirements for each degree are the following. Master of Science (M.S.), Thesis The M.S. thesis degree program requires 30 credit hours, and the following specific requirements must be met: 18 credit hours of senior and graduate-level coursework (subject to M.S. thesis course restrictions); 9 credit hours of Thesis, ECE 5994; 2 credit hours of Seminar, ECE 5944; 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; and An oral final examination consisting of a thesis defense must be passed. Master of Science (M.S.), Non-Thesis The M.S. non-thesis degree program is a coursework-only degree that requires 30 credit hours, does not require a final examination, and the following specific requirements must be met: 27 credit hours of senior and graduate-level coursework (subject to M.S. non-thesis course restrictions); 2 credit hours of Seminar, ECE 5944; and 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304. The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

PhD Degree

TOEFL

Paper: (590.0)

iBT: (96.0)

GRE

General: Verbal (153.0), Quantitative (157.0), Analytical (4.5)

Regular Ph.D. Requirements (for students with a master's degree not earned at Virginia Tech) The regular Ph.D. degree program requires 90 credit hours, and the following specific requirements must be met: 27 credit hours of course work (subject to Ph.D. course restrictions); 60 credit hours of research and thesis, ECE 7994; 2 credit hours of Seminar, ECE 5944; and 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; Direct-PhD Requirements (for students with only an earned bachelor's degree) Obtaining a Ph.D. through the Direct-Ph.D. degree program requires 90 credit hours, and the following specific requirements must be met (depending on whether an M.S. Thesis or an M.S. Non-Thesis degree is obtained): M.S. Thesis and Ph.D. Completing a Computer Engineering M.S. Thesis degree (coursework transfers to Ph.D. subject to Ph.D. course restrictions); 9 additional credit hours of coursework for PhD (subject to Ph.D. course restrictions); 60 credit hours of research and thesis, ECE 7994; 2 credit hours of Seminar, ECE 5944 (will count for both M.S. and Ph.D. degrees); 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; (will count for both M.S. and Ph.D. degrees). M.S. Non-Thesis and Ph.D. Completing a Computer Engineering M.S. Non-Thesis degree (coursework transfers to Ph.D. subject to Ph.D. course restrictions); 60 credit hours of research and thesis, ECE 7994; 2 credit hours of Seminar, ECE 5944 (will count for both M.S. and Ph.D. degrees); 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; (will count for both M.S. and Ph.D. degrees). The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

GRADUATE COURSES (ECE)

ECE 5014:

Research and Development Methods for Engineers

Research and development methods for engineers. Scientific literature searches using bibliometric tools such as Google Scholar and Web of Science. Introduction and significance of the Hirsh-Factor for measurement of scientific productivity. Issues of ethics and integrity including: plagiarism, text reuse, and data falsification; and real-world examples such as the Schon scandal case at Bell Labs. The establishment of the postwar American innovation system as proposed in "Science the Endless Frontier," a report to the president by Vannevar Bush. An introduction to patent law and intellectual property as it applies to academic and industrial research. Not for CPE-MS, EE-MS, CPE-PhD, or EE-PhD credit. May be taken for CPE-MEng or EE-MEng credit.

Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5104G:

Advanced Microwave and RF Engineering

Passive and active RF and microwave components and circuits for wireless communications: transmission-line theory; planar transmission-lines and waveguides; S-parameters; resonators; power dividers and couplers; microwave filters; sources, detectors, and active devices; modern RF & microwave CAD. Active RF components. Microwave amplifier design. Microwave Integrated Circuits (MIC). RF Microelectromechanical System (MEMS) components. Microwave systems. RF components for wireless systems. RF components for Ultra Wide band (UWB) systems. Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5105:

Electromagnetic Waves

5105: Fundamentals of pane wave propagation, reflection, and transmission; basic theorems, equivalent currents, and Greens theory; radiation fields generated by current sources. 5106: Electromagnetic fields in the presence of inhomogeneous media; separation of variables; analyses of waveguide, cavity, radiation, and scattering problems; numerical methods. Pre: 5105: Graduate standing; 5106: 5105.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5106:

Electromagnetic Waves

5105: Fundamentals of plane wave propogation, reflection, and transmission; basic theorems, equivalent currents, and Greens theory; radiation fields generated by current sources. 5106: Electromagnetic fields in the presence of inhomogeneous media; separation of variables; analyses of waveguide, cavity, radiation, and scattering problems; numerical methods. Pre: 5105:Graduate standing; 5106: 5105.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   ECE 5105

Corequisite(s):

ECE 5134G:

Advanced Fiber Optics and Applications

Theory of optical fiber waveguide propagation and design applications in communication and sensing systems. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5144:

Introduction to Electro-Optics

Physical optics, wave propagation in inhomogeneous media, acousto-optic and electro-optic effects and their applications in intensity modulation and phase modulation of laser beams. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   (ECE 3106 (UG), ECE 3614 (UG)) OR (ECE 3106, ECE 3614)

Corequisite(s):

ECE 5154:

Optical Fiber Sensors

Introduction of basic concepts and definitions in measurement science. Principles of single point sensors including intensity-based, fiber Bragg gratings, gyroscopic and interferometric fiber devices. Time and wavelength division sensor multiplexing techniques. Distributed fiber sensors based on Rayleigh scattering and other optical nonlinearities. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5164 (AOE 5654):

Introduction to Space Science I: The Solar Wind and Magnetosphere

Describes the space environment from the sun to the earths upper atmosphere. Fundamental concepts in space plasma physics will be presented, as needed, throughout the course. Numerous examples of observations and data will be utilized to illustrate the environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment (space weather) on modern technologies such as solid state devices, satellite technology, communication and global navigation systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 3106 (UG) OR ECE 3106

Corequisite(s): ECE 5105

ECE 5174 (AOE 5174):

Introduction to Plasma Science

Underlying physical processes and basic computational techniques for laboratory, space, and technological plasma environments including single particle motion, fluid and kinetic theory of plasmas, plasma waves and instabilities, diffusion and resistivity, and nonlinear effects. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5194:

Remote Sensing: Principles and Techniques

Physical principles involved in remote sensing of Earths environment and their implementation in engineering systems; societal applications of remote sensing; fundamental principles of electromagnetic wave propagation and scattering; passive versus active techniques; remote sensing platforms and systems integration; advanced concepts important for the design and analysis of remote sensing engineering systems. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5200 (MSE 5200):

Semiconductor Alloys and Heterstructures

Advanced treatment of semiconductor materials with an emphasis on binary compounds, ternary and quaternary alloys, and strained-layer structures. Topics include crystal structure; lattice vibrations and phonons; energy band structure; equilibrium and non-equilibrium carrier distributions; electron and hole transport via diffusion and drift; and carrier generation and recombination mechanisms. Graduate standing required in the College of Engineering or College of Science.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MSE 3204 (UG) OR ECE 4214 (UG) OR PHYS 3455 (UG) OR ECE 4214 OR MSE 3204 OR PHYS 3455

Corequisite(s):

ECE 5204:

Power Semiconductor Devices

Characteristics, fabrication, and application of power semiconductor devices, which may include p-i-n and Schottky diodes, insulated gate biopolar transistors, field effect transistors, and thyristors. Effect of semiconductor material, device structure, and current injection levels on device performance. Device drive requirements and power circuit interaction. Implementation of power devices using wide band gap semiconductors such as silicon carbide and gallium nitride.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5200

Corequisite(s):

ECE 5205:

Basic Semiconductor Devices

Description of the performance characteristics and limitations of basic semiconductor electronic devices in terms of the properties of semiconductor materials and device structure.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5210:

MicroElectroMechanical Systems: From Fabrication to Application

MicroElectroMechanical Systems (MEMS) are very-small systems or systems made of very small components. The course focuses on the design, fabrication, and application of microsystems providing a unique opportunity for interdisciplinary interactions. The course consists of lectures, readings from the current literature, discussion by students, and team-work projects. The major topics covers are: materials in MEMS; microfabrication techniques; sensing and actuating mechanisms; wafer-level packaging; and case-study of some MEMS-based devices and lab-on-a-chip systems. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4234 (UG) OR ECE 4234 OR BCHM 4124 (UG) OR BCHM 4124 OR CHE 4114 (UG) OR CHE 4114 OR CHEM 4124 (UG) OR CHEM 4124 OR ESM 4014 (UG) OR ESM 4014 OR ESM 4024 (UG) OR ESM 4024 OR ME 4304 (UG) OR ME 4304 OR ME 4404 (UG) OR ME 4404 OR MSE 4254 (UG) OR MSE 4254 OR MSE 4354 (UG) OR MSE 4354

Corequisite(s):

ECE 5224:

Principles of Electronics Packaging

Electrical, thermal, mechanical, and thermomechanical design of electronics packaging. Materials and process selection guidelines for the fabrication and reliability of single- and multi-chip electronics packages. Methods for characterization and testing of electronics packages. Failure mechanisms and design for reliability. Hands-on project experience on electronics packaging. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5234:

Emi and Noise Reduction Techniques and Filter Design

Theory and practice of electromagnetic interference (EMI) noise coupling; techniques for noise reduction; shielding, grounding and filtering. Limitations of circuit theory, parasitics in circuits and their physical origins, measurement of EMI to comply with government regulation. EMI problems and solutions to switching power supply applications. Design of EMI filter, magnetics design, eddy currents. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5244:

Advanced Power Conversion Techniques

High-frequency resonant, quasi-resonant, and multi-resonant power conversion techniques; zero-voltage and zero-current switching techniques in pulse-width modulation converters and inverters. Pulse-width modulation and frequency modulation; non-linear analysis techniques for resonant and soft-switching converters and inverters. Power factor correction rectifiers and distributed power systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4224 (UG) OR ECE 4224

Corequisite(s):

ECE 5254:

Power Converter Modeling and Control

Nonlinear modeling of power conversion circuit using discrete and average techniques analysis and design of voltage mode and current mode control; parallel module operation and system interactions; distributed power systems; time domain simulation and frequency domain measurement techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4224 (UG) OR ECE 4224

Corequisite(s):

ECE 5264:

Advanced Power Electronics Laboratory

Study of advanced control and high frequency modeling of power converters; analysis and design of high-frequency power converters; analysis of high-frequency magnetic components; analysis and design of embedded power management solutions for distributed power systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5254

Corequisite(s):

ECE 5274:

Modeling and Control of Three-Phase PWM Converters

Power conversion principles for three-phase pulse-width modulation techniques, control and converters. Development of averaged models of three-phase rectifiers and inverters in stationary and rotating coordinates. Small-signal models in rotating coordinates and control design. Introduction of switching state vectors and different modulation

schemes. Three-phase inverter and rectifier applications. Parallel and multi-level three-phase converters. Alternate years. Prerequisite or equivalent.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4224 (UG) OR ECE 4224
Corequisite(s):

ECE 5284:
Energy Harvest Circuit Design
Energy sources for energy harvesting. Equivalent circuits for various transducers including piezoelectric (PZT), electromagnetic generators, photovoltaic cells, and thermoelectric generators. Power management circuits (PMCs) and maximum power point tracking (MPPT) schemes for piezoelectric cantilevers. PMCs for electromagnetic and electrostatic generators, and photovoltaic modules. MPPT schemes for photovoltaic modules under full sun and partial shading. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5314:
Power System Operation and Control
A course dealing with modern power system operational and control problems and solution techniques. State estimation, contingency analysis, load-frequency control, and automatic generation control. Load flow analysis and external equivalents for steady-state operations.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4334 (UG) OR ECE 4334
Corequisite(s):

ECE 5324:
Power System Planning
A study of generation planning, bulk power supply systems, production costing analysis, and load forecasting. Dispersed generation. Electric power system reliability and stability.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4334 (UG) OR ECE 4334
Corequisite(s):

ECE 5334:
Transients in Power Systems
Wave propagation, wave propagation on multiconductor systems, lightning phenomena, grounding for protection against lightning, direct lightning strokes to overhead lines without and with shield wires, fundamental concepts of switching transients, switching surge phenomena, system performance under switching surges, dynamic overvoltages, performance of power apparatus under transient voltages, surge arresters, insulation coordination, electromagnetic transient programs (EMTP). Pre: Graduate standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5374G:
Adv Alternate Energy Systems
Electric energy from alternative energy sources including solar, wind, hydro, biomass, geothermal and ocean. Characteristics of direct conversion, electromechanical conversion, and storage devices used in alternative energy systems. Power system issues associated with integration of small-scale energy sources into the electricity grid. System level cost benefit analysis. Prerequisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5404:
Advanced Analog Integrated Circuit Design
Complementary Metal–Oxide–Semiconductor (CMOS) technology; Analog and mixed-signal Integrated Circuits (ICs) design, and techniques to analyze and optimize performance metrics, such as: speed, area, power and signal integrity; Clocking, interconnect and scaling issues of ICs; Op Amp and Comparator, Voltage References, Integrated Filter, analog to digital converter (ADC), digital to analog converter (DAC), and phase-locked loop (PLL); Computer Aided Design (CAD) tools – schematic, layout, extraction and circuit simulation; Advanced topics including ICs' high frequency performance issues,

emerging nano-devices, advanced fabrication technologies, three dimension (3D) ICs, and neuromorphic computing. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5414 (CS 5264):

Advanced Linux Kernel Programming

Design and internal organization of the Linux operating system kernel. Kernel subsystems, boot process, memory management, process and thread model, scheduling, interrupt and exception handling, virtual file system and the concrete file system, block I/O and I/O scheduler, network stack, and device drivers. Modification of existing kernel code. Design, implementation, test, and evaluation of new kernel modules. Kernel and full software stack debugging techniques, and virtualization as an aid for operating system development and debug. Software engineering techniques to analyze, modify and run a large, complex open-source code base. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5424 (CS 5824):

Advanced Machine Learning

Algorithms and principles involved in machine learning; focus on perception problems arising in computer vision, natural language processing and robotics; fundamentals of representing uncertainty, learning from data, supervised learning, ensemble methods, unsupervised learning, structured models, learning theory and reinforcement learning; design and analysis of machine perception systems; design and implementation of a technical project applied to real-world datasets (images, text, robotics). Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5434:

Cyber-Physical Systems

Modeling formalism of Cyber-Physical Systems (CPS). Modeling of physical and cyber systems; software synthesis from these modeling formalisms; supporting operating systems and hardware architectures for CPS; critical requirements of CPS and their validation/verification; and CPS case studies. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5444:

Advanced Technological Singularity

Investigation, conceptualization and analysis of Technological Singularity -- the potential impact of true artificial machine intelligence on engineering and society. Historical perspectives. Barriers to whole brain emulation and the engineering of superintelligence. The role of consciousness in achieving true machine intelligence. Potential scenarios if superintelligence would come into being. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5454:

Optimization Techniques for Electrical and Computer Engineering

Convex optimization theory and algorithms and their application to electrical and computer engineering. Sparse optimization methods, eigen-decomposition techniques, the expectation-maximizing algorithms, stochastic optimization techniques, and special techniques relevant to large-scale optimization.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5605

Corequisite(s):

ECE 5464:

Applications of Machine Learning

Applications of Machine Learning (ML) for predictive data analytics. Probability for ML including conditional probability, the product and chain rule, and the Theorem of Total Probability. Data preparation for ML algorithms, normalization, cleaning, and imputation of missing values. Information-based learning using decision trees. Similarity-based methods, data classification and clustering. Probability-based learning, conditional probability and Bayes' theorem, and applications. Linear and logistic regression and optimization-based learning. Performance evaluation of ML systems. Artificial Neural Networks. Real-world applications of ML and case studies. Not for CPE-MS, EE-MS, CPE-PhD, or EE-PhD credit. May be taken for CPE-MEng or EE-MEng credit. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5480:

Cybersecurity and the Internet of Things

Cybersecurity principles and technologies motivated by the evolving ecosystem of Internet of Things (IoT): devices, operating systems, sensors, data storage, networking and communication protocols, and system services. IoT device and system security and privacy vulnerabilities, analysis, and attack mitigation techniques. Master of Information Technology (MIT) students only.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5484 OR CS 5044

Corequisite(s):

ECE 5484:

Fundamentals of Computer Systems

Fundamental principles and concepts of computer systems. Computer hardware; Boolean logic; number systems and representation; design and operation of digital logic; analysis of instruction set architectures and computer organization; and specification of data communication and networking standards. Master of Information Technology (MIT) students only. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5485:

Networks and Protocols

5485: Fundamental principles and concepts of computer networks; application, transport, network, and data link protocols. Contemporary and emerging networks; Internet protocols. Principles of quality of service, network security, and network management. 5486: Performance evaluation via analysis, simulation, and experimental methods of networks and network protocols. Wireless and mobile network technologies and protocols; wireless local area networks, cellular systems, sensor networks and the Internet of Things (IoT). Mobility in the Internet and application support for mobility. Master of Information Technology (MIT) students only. Partially duplicates ECE/CS 5565-5566.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5484, CS 5044

Corequisite(s):

ECE 5486:

Networks and Protocols

5485: Fundamental principles and concepts of computer networks; application, transport, network, and data link protocols. Contemporary and emerging networks; Internet protocols. Principles of quality of service, network security, and network management. 5486: Performance evaluation via analysis, simulation, and experimental methods of networks and network protocols. Wireless and mobile network technologies and protocols; wireless local area networks, cellular systems, sensor networks and the Internet of Things (IoT). Mobility in the Internet and application support for mobility. Master of Information Technology (MIT) students only. Partially duplicates ECE/CS 5565-5566.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5485

Corequisite(s):

ECE 5494:

Innovation Pathways in Artificial Intelligence and Machine Learning

Convergence of digital technologies in networked devices, big data, and advanced breakthroughs in artificial intelligence (AI) and machine learning (ML). Meaning, theory, and construction of socio-technical systems. Analysis of technical aspects and opportunities of AI/ML systems in organizations. Technosystem due diligence of advanced AI/ML systems. Assessment of the viability of emerging technological solutions. Social impacts of disruptive change upon individuals, organizations, and society-at-large. Frameworks for the design and implementation of advanced AI/ML systems. Planning for the future of AI/ML. Master of Information Technology (MIT) students only.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5484 OR MGT 5804

Corequisite(s):

ECE 5504 (CS 5504):

Computer Architecture

Advanced computer architectures, focusing on multiprocessor systems and the principles of their design. Parallel computer models, programming and interconnection network properties, principles of scaleable designs. Case studies and example applications of pipeline processors, interconnection networks, SIMD and MIMD processors.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4504 (UG) OR ECE 4504

Corequisite(s):

ECE 5505:

Testing and Verification of Digital Systems

Various topics on digital circuit testing and verification. 5505: digital circuit testing including simulation, test pattern generation, design for testability, built-in-self-test, and diagnosis. Graduate standing in ECE is required. 5506: circuit verification including two-level and multi-level circuit verification, sequential circuit verification, model-checking simulation-based verification, and ATPG-based verification. Graduate standing in ECE required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECPE 4505

Corequisite(s):

ECE 5506:

Testing and Verification of Digital Systems

Various topics on digital circuit testing and verification. 5505: digital circuit testing including simulation, test pattern generation, design for testability, built-in-self-test, and diagnosis. 5506: circuit verification including two-level and multi-level circuit verification, sequential circuit verification, model-checking simulation-based verification, and ATPG-based verification. Graduate standing in ECE required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECPE 4505

Corequisite(s):

ECE 5510 (CS 5510):

Multiprocessor Programming

Principle and practice of multiprocessor programming. Illustration of multiprocessor programming principles through the classical mutual exclusion problem, correctness properties of concurrency (e.g., linearizability), shared memory properties (e.g. register constructions), and synchronization primitives for implementing concurrent data structures (e.g., consensus protocols). Illustration of multiprocessor programming practice through programming patterns such as spin locks, monitor locks, the work-stealing paradigm and barriers. Discussion of concurrent data structures (e.g., concurrent linked lists, queues, stacks, hash maps, skiplists) through synchronization patterns ranging from coarse-grained locking to fine-grained locking to lock-free structures, atomic synchronization primitives, elimination, and transactional memory. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4534 OR ECE 4550

Corequisite(s):

ECE 5514:

Design of Systems on a Chip

Current state of the art in the system-level design of Systems on a Chip. The focus is in hardware, scheduling, and applications at the highest levels of design. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4514 (UG) OR ECE 4514

Corequisite(s):

ECE 5534:

Electronic Design Automation

This course introduces graduate students to the various design automation artifacts, algorithms, and methodologies. It includes system level design languages, abstractions, models of computation, high level

synthesis, modeling and model transformations, and simulation based validation. The course deals with state of the art design practices. It requires a solid back-ground in computer architecture, digital design, and proficiency in programming and modeling.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4514 (UG) OR ECE 4514
Corequisite(s):

ECE 5544 (CS 5544):

Compiler Optimizations

Overview of compilation and compiler optimizations. Design and internal organization of the Low-Level Virtual Machine compiler infrastructure. Static Single Assignment. Data-flow analysis and techniques for reaching definitions, live variable analysis, and available expressions. Lattice theory and iterative algorithms for general frameworks. Non-separable dataflow analysis including constant propagation and folding, faint variable analysis, and points-to may/must analysis. Loop-invariant code motion and lazy code motion. Static Single Assignment construction and optimizations. Register allocation and coalescing. Pointer analysis using Anderson's and Steensgaard's algorithms, and liveness analysis of heap data. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5545:

Advanced VLSI Design

Advanced concepts in CMOS-based digital system are studied. The topics include implementation of special purpose structures for complex digital systems, automation and verification of the design process, and design for testability (5545); and design techniques for low-power design, power dissipation estimation, and application of low-power techniques in the different levels of the design hierarchy (5546).
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4540 (UG) OR ECE 4540
Corequisite(s):

ECE 5550G:

Advanced Real-Time Systems

Theory, algorithmic and protocol concepts, mechanisms, and implementations of real-time computer systems. Introduction to real-time systems, real-time scheduling, real-time synchronization, real-time operating systems kernels, and real-time programing languages. Design and analysis of real-time resource management algorithms (e.g., scheduling, synchronization), their implementations in production operating system kernels, experimental studies of those implementations, and real-time application development. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5554:

Computer Vision

Techniques for automated analysis of images and videos. Image formation, feature detection, segmentation, multiple view geometry, recognition, and video processing. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): null null

ECE 5560 (CS 5560):

Fundamentals of Info Security

Principles of information security and relevant mathematical concepts. Classical ciphers, relevant abstract algebra and number theory, symmetric-key ciphers, cipher modes of operation, and asymmetric-key ciphers. Cryptography and cryptosystems. Applications and standards relevant to network and computer security. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5564:

Wearable and Ubiquitous Computing

Issues in the design and use of wearable and ubiquitous computing systems. Topics covered include current research issues in system-level

low power design, input/output devices, location and context-awareness, and networking. Students are expected to design, implement, and evaluate a wearable computing device or application.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):   ECE 4534 (UG) OR ECE 4550 (UG) OR ECE 4534 OR ECE 4550
Corequisite(s):

ECE 5565 (CS 5565):
Network Architecture and Protocols
5565: Principles and concepts of networking and protocols, with emphasis on data link, network, and transport protocols. Contemporary and emerging networks and protocols to illustrate concepts and to provide insight into practical networks including the Internet. Quantitative and qualitative comparisons of network architectures and protocols. 5566: Performance evaluation, design, and management of networks. Use of queuing and other analytical methods, simulation, and experimental methods to evaluate and design networks and protocols. Network management architectures and protocols. Graduate standing in EE, ECE, CS, or IT is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):   STAT 4714 (UG) OR STAT 4714
Corequisite(s):

ECE 5566 (CS 5560):
Network Architecture and Protocols
5565: Principles and concepts of networking and protocols, with emphasis on data link, network, and transport protocols. Contemporary and emerging networks and protocols to illustrate concepts and to provide insight into practical networks including the Internet. Quantitative and qualitative comparisons of network architectures and protocols. 5566: Performance evaluation,d esign, and management of networks. Use of queuing and other analytical methods, simulation, and experimental methods to evaluate and design networks and protocols. Network management architectures and protocols. Graduate standing in EE, ECE, CS or IT is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):   ECE 5565 (UG) OR ECE 5565
Corequisite(s):

ECE 5580:
Cryptographic Engineering
Implementation of cryptographic operations and protocols in contemporary computing platforms. Mapping of cryptographic operations, evaluation and optimization of performance and implementation cost, analysis of security against brute- force cryptanalysis and implementation-level attacks, security-testing procedures, and architectures to support a trusted computing base.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):   ECE 5560 OR CS 5560
Corequisite(s):

ECE 5584 (CS 5584):
Network Security
Fundamentals of network security. Network security architecture, user and attacker perspective. Practical applications and security standards. Protocol design principles and their impact on computer and network security. Authentication systems. Email security. Firewalls and intrusion detection. Security for wireless systems. Pre: Graduate standing in CSA.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5585:
IT Security and Trust
5585: Fundamental Internet and computer security principles and applications; legal and privacy issues, risk analysis, attack techniques, intrusion detection concepts, basic computer forensics, and system and application security hardening techniques. 5586: Advanced security and trust concepts and implementation in wired and wireless computer networks and computer systems; malware defenses, impact of channel fragility, node mobility, cooperative functionality, and resource constraints on security and trust at the different layers of the Internet protocol stack. Pre: Graduate standing for 5585.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

ECE 5586:

IT Security and Trust

5585: Fundamental Internet and computer security principles and applications; legal and privacy issues, risk analysis, attack techniques, intrusion detection concepts, basic computer forensics, and system and application security hardening techniques. 5586: Advanced security and trust concepts and implementation in wired and wireless computer networks and computer systems; malware defenses, impact of channel fragility, node mobility, cooperative functionality, and resource constraints on security and trust at the different layers of the Internet protocol stack. Pre: Graduate standing for 5585.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5585

Corequisite(s):

ECE 5590 (CS 5590):

System and Software Security

Secure software design, memory and file system security, operating system security for various platforms. Program classification, anomaly detection, malware detection and analysis. Technical challenges and problems in securing operating systems and software. Classic and modern algorithms, models, principles, and tools for system and application software security. Actual security examples.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5560 OR ECE 5560

Corequisite(s):

ECE 5605 (BMES 5525):

Stochastic Signals and Systems

5605: Engineering applications of probability theory, random variables and random processes. Time and frequency response of linear systems to random inputs using both classical transform and modern state space techniques. 5606: Response of continuous and discrete time, linear and nonlinear systems to Gaussian and non-Gaussian random processes. Introduction to signal detection theory and optimal filtering (estimation) techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 4714 (UG) OR STAT 4714

Corequisite(s):

ECE 5606:

Stochastic Signals and Systems

5605: Engineering applications of probability theory, random variables and random processes. Time and frequency response of linear systems to random inputs using both classical transform and modern state space techniques. 5606: Response of continuous and discrete time, linear and nonlinear systems to Gaussian and non-Gaussian random processes. Introduction to signal detection theory and optimal filtering (estimation) techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5605 (UG) OR ECE 5605

Corequisite(s):

ECE 5620:

Advanced DSP and Filter Design

Advanced analysis, design, and realization of digital filters. Efficient Discrete Fourier Transform algorithm implementations, finite wordlength arithmetic, fixed point implementation, limit cycles, noise shaping, decimation and interpolation, multi-rate digital filter design, Hilbert transformers, analytic signal generation, basic adaptive filtering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 4624 (UG), STAT 4714 (UG)) OR (ECE 4624, STAT 4714)

Corequisite(s):

ECE 5634:

Information Theory

Transmission of information over noisy channels. Measures of information and transmission channel capacity. Use of codes to improve the reliability of such transmission. Mathematical theory of information. Transmission at rates above channel capacity. Includes linear codes, error detecting and correcting codes, Hamming codes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (STAT 4714 (UG), ECE 4634 (UG), ECE 5605 (UG))

OR (STAT 4714, ECE 4634, ECE 5604)

Corequisite(s):

ECE 5635:

Radar Systems Analysis and Design

5635: This graduate-level course is the first in a two-part sequence in radar analysis and design. It covers the theory and practice of radar systems used for detection, tracking and location of targets. Topics include measurement of range and velocity, pulse compression, design of radar transmitter, receivers and antennas. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5605

Corequisite(s):

ECE 5636:

Radar Systems Analysis and Design

5636: This graduate-level course is the second in a two-part sequence in radar analysis and design. It covers signal processing techniques used in pulsed radar systems. Topics include signal modeling, matched filter, frequency-modulated pulse compression waveforms, pulse Doppler processing, the Neyman-Pearson detection theory, constant false-alarm rate detection, beamforming and space-time adaptive processing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5635

Corequisite(s):

ECE 5644:

Game Theory for Communication Networks

Analysis and optimization of large-scale engineering systems and communication networks using game theory. Introduction to the basics of game theory and its two branches- noncooperative and cooperative games-with application to the design of emerging communication systems and networks. A comprehensive treatment of the basics of game theory and learning with communication networking examples drawn from various areas such as cellular networks, mobile ad hoc networks, and related fields. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5654:

Digital Communications II: Advanced Theory and Analysis

Fundamentals of the theory, design, and analysis of modern digital communication systems. Representation of signal in digital form. Design and analysis of digital modulation formats and receivers using signal space techniques. Combining error correction techniques with digital modulation. Viterbi algorithm for maximum likelihood sequence estimation. Equalization and adaptive equalization. Fading channels and diversity techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 4634 (UG), ECE 5605 (UG)) OR (ECE 4634, ECE 5605)

Corequisite(s):

ECE 5660:

Spread Spectrum Communications

Major topics include: direct sequence and frequency hopping methods, synchronization, resistance to jamming, low probability of detection, spreading codes and their generation, system performance, RAKE receivers, Code Division Multiple Access, cellular CDMA applications, wireless LAN applications, as well as commercial and military applications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 4634 (UG), ECE 5605 (UG)) OR (ECE 4634, ECE 5605)

Corequisite(s):

ECE 5664:

Cellular Communication Systems

Fundamental theory, design tradeoffs and practical issues of high capacity wireless communications systems. Trunking, RF propagation, frequency reuse, and legacy and emerging radio communications systems, including Long Term Evolution (LTE) cellular networks.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5605

Corequisite(s):

ECE 5674:

Software Radios: Modern Radio Engineering

An introduction to software radios, devices that can be programmed to work with a variety of different radios. The course will cover the following topics: software radio architectures, existing software radio efforts, a review of basic principles, an analysis of receiver operation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 4624 (UG), ECE 4634 (UG)) OR (ECE 4624, ECE 4634)

Corequisite(s):

ECE 5704 (ME 5704):

Robotics and Automation

Automation, mechatronics, robot technology, kinematics, dynamics, trajectory planning, and control of two-dimensional and spatial robots; robot programming; design and simulation of robotic devices. Laboratories associated with robot forward/inverse kinematics, task planning, velocity kinematics, force rendering, control, haptics, mobile robotics, mapping/localization, computer vision and path planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5714:

Robust Estimation and Filtering

An introduction to the analysis and design of maximum likelihood and robust estimators and filters. Maximum likelihood estimation theory: consistency, asymptotic efficiency, sufficiency. Robust estimation theory: qualitative robustness, breakdown point, influence function, change-of-variance function. Robust estimators: M-estimators, generalized M-estimators, high-breakdown estimators. Robust estimation of ARIMA models; Robust Kalman filter. Long memory processes: Hurst parameter estimation; parameter estimation of fractional ARIMA models. Applications to image and speech processing, communications, radar systems, and electric power systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5605

Corequisite(s):

ECE 5734 (ME 5584) (AOE 5734):

Convex Optimization

Recognizing and solving convex optimization problems. Convex sets, functions, and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5744 (AOE 5744) (ME 5544):

Linear Systems Theory

Advanced introduction to the theory of time-varying and time-invariant linear systems represented by state equations; solutions of linear systems, uniform stability and other stability criteria, uniform observability and controllability, state feedback and observers. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 OR ECE 4405 (UG) OR ECE 4624 (UG) OR ECE 4624 OR ECE 4634 (UG) OR ECE 4634 OR ME 4504 (UG) OR ME 4504 OR AOE 4004 (UG) OR AOE 4004

Corequisite(s):

ECE 5754 (AOE 5754) (ME 5554):

Applied Linear Systems

Develop an applied understanding of state-space representations for linear time invariant multi-input multi-output dynamic systems in both time domain and frequency domain. Introduction to modern state-space control methods; state feedback and output feedback. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 OR ECE 4624 OR ECE 4634 OR ME 4504 OR AOE 4004 OR ECE 4405 (UG) OR ECE 4624 (UG) OR ECE 4634

(UG) OR ME 4504 (UG) OR AOE 4004 (UG)
Corequisite(s):

ECE 5764 (ME 5564) (AOE 5764):
Applied Linear Control
Analysis and design of sampled-data systems, extraction of discrete-time dynamic models from experimental data, and implementation of dynamic compensators on digital processors. In-depth design experience with LQR optimal control and an introduction to Kalman filtering. Realistic design problems with numerical simulations of practical implementations.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5744 OR ECE 5754 OR ME 5554 OR ME 5544 OR AOE 5744 OR AOE 5754
Corequisite(s):

ECE 5774 (AOE 5774) (ME 5574):
Nonlinear Systems Theory
Introduction to the theory of systems of coupled, nonlinear, time-varying ordinary differential equations: existence and uniqueness of solutions; continuous dependence on parameters; stability of equilibria and stability analysis techniques; input-to-state stability; input-output stability; nonlinear design techniques including input-state and input-output feedback linearization, backstepping, and sliding mode control. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5805:
Graduate Design Project and Report
Industry-like two semester, team-based design experience. Design and implement solutions to meet multiple realistic constraints; design to incorporate appropriate engineering standards. A specific, complex engineering design problem taken from problem definition to product realization and testing. Written and oral communication, professional development, project management, and working within a team. 5805: Determine and formulate an engineering problem with multiple realistic constraints. Generate and select design alternatives. Apply design and analysis methods to develop, evaluate, and communicate a detailed project design. 5806: Implement and refine the project design from ECE 5805. Test, analyze, document, and deliver the resulting project outcomes. A final oral and written examination that satisfies the Master of Engineering (MEng) program requirements. Pre: Graduate standing in Electrical Engineering and Computer Engineering Master of Engineering degree students only for 5805; 5805 (B) for 5806.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5806:
Graduate Design Project and Report
Industry-like two semester, team-based design experience. Design and implement solutions to meet multiple realistic constraints; design to incorporate appropriate engineering standards. A specific, complex engineering design problem taken from problem definition to product realization and testing. Written and oral communication, professional development, project management, and working within a team. 5805: Determine and formulate an engineering problem with multiple realistic constraints. Generate and select design alternatives. Apply design and analysis methods to develop, evaluate, and communicate a detailed project design. 5806: Implement and refine the project design from ECE 5805. Test, analyze, document, and deliver the resulting project outcomes. A final oral and written examination that satisfies the Master of Engineering (MEng) program requirements. Pre: Graduate standing in Electrical Engineering and Computer Engineering Master of Engineering degree students only for 5805; 5805 (B) for 5806.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5805
Corequisite(s):

ECE 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5904:
Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ECE 5944:

Seminar

To acquaint graduate students with recent and current research results and trends and to introduce researchers to students performing important work in Electrical and Computer Engineering.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ECE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ECE 6104:

Advanced Topics in Electromagnetics

Advanced topics of current interest in Electromagnetic Engineering. Topics are selected from current technical literature. May be repeated for credit.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s):

ECE 6115:

Antenna Theory and Design I,II

6115: Antenna systems and arrays: antennas in systems, antenna synthesis array fundamentals, array excitation and mutual impedance, waveguide slot arrays, microstrip antennas, microstrip elements, microstrip planar and conformal arrays, numerical methods for antenna analysis, Method of Moments and FDTD, antenna measurements, phased arrays. 6116: Reflectors and aperture antennas: aperture theory, analytical and computer-based designs, reflector antenna fundamentals, numerical methods for reflector analysis, general formulation of GO, PO, GTD, PTD and UTD methods, Gaussian beams, reflector optic configurations, prime-symmetric, Gregorian, Cassegrain and prime-offset reflector systems, analysis of strut scattering, aperture blockage, spillover, G/T analysis, measuring and commissioning reflector systems, reflector feed array, focal plane arrays, defocused arrays.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s): null null

ECE 6116:

Antenna Theory and Design I,II

6115: Antenna systems and arrays: antennas in systems, antenna synthesis, array fundamentals, array excitation and mutual impedance, waveguide slot arrays, microstrip antennas, microstrip elements, microstrip planar and conformal arrays, numerical methods for antenna analysis, Method of Moments and FDTD, antenna measurements, phased arrays. 6116: Reflectors and aperture antennas: aperture theory, analytical and computer-based designs, reflector antenna fundamentals, numerical methods for reflector analysis, general formulation of GO, PO, GTD, PTD and UTD methods, Gaussian beams, reflector optic configurations, prime-symmetric, Gregorian, Cassegrain and prime-offset reflector systems, analysis of strut scattering, aperture blockage, spillover, G/T analysis, measuring and commissioning reflector systems, reflector feed array, focal plane arrays, defocused arrays.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s): null null

ECE 6124:

Advanced Numerical Electromagnetics

A thorough coverage of numerical methods for electromagnetics, including topics on the foundations of function theory, Greens functions, mode-matching, and numerical expansion techniques in both the time and frequency domains. Emphasis will be placed on the method of moments and the finite element method, with development of the theoretical foundations of these methods. Alternate year course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5106 (UG) OR ECE 5106

Corequisite(s):

ECE 6154:

Photonic Devices and Systems

Electromagnetic analysis of guided-wave optical devices and systems, including transmission properties of optical fibers, photonic crystal waveguides, grating structures, and coupled-wave components; soliton propagation in fibers; Erbium-doped and Raman fiber amplifiers; semiconductor light sources and photodetectors; wavelength-division multiplexed systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s):

ECE 6174 (CS 5504):

Computational Plasma Dynamics

Computational techniques for investigating processes in plasmas over a broad range of spatial and temporal scales. Investigation of physical processes including electrodynamics, waves and turbulence, space propulsion, spacecraft environmental effects and various laboratory applications. Computational techniques including full Particle-in-Cell (PIC), hybrid (fluid-electron, PIC ion), magnetohydrodynamics MHD and two-fluid methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5174 OR AOE 5174

Corequisite(s):

ECE 6204:

Advanced Topics in Electronics

Advanced topics of current interest in electronics engineering, with particular emphasis on microelectronics. Topics are selected from current technical literature to stress and reflect important potential areas in the electronic field. These topics include multichip modules, electronic packaging, microwave packaging, modeling simulation and evaluation of high speed devices, wideband characterization of electronic materials and multilayer structures, time and frequency domain measurement techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 6214:

Optoelectronic Devices

Principles of light generation and detection, operation, and design of state-of-the art optoelectronic and photonic devices. Advanced treatment of the operating principles of semiconductor optoelectronic devices with direct comparison to experimental data reported in the literature.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5200

Corequisite(s):

ECE 6304:

Advanced Topics in Power

Advanced topics of current interest in Electric Power Engineering. Topics are selected from current technical literature. Certain topics may be repeated.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 6314:

Advanced Instrumentation in Power Systems

Role of advanced instrumentation in monitoring, control and protection applications in power systems. Effects and limitations of instrument transformers, signal conditioning circuits, analog to digital (A/D) converters and Digital Signal Processing (DSP) chips, time synchronization and sampling, output circuits and devices, and communication channels. Fast Fourier Transform (FFT), protection algorithms, phasor and frequency measurements.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5314

Corequisite(s):

ECE 6334:

Computational Methods in Power Engineering

This course is designed to introduce various linear and nonlinear program based optimization algorithms that are specially suited for the design, analysis and operation of electric power systems, power processing devices, machines, and transformers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5324 (UG) OR ECE 5324

Corequisite(s):

ECE 6354:

Power System Dynamics and Control

Dynamic modeling, stability analysis, and control of multi-machine power systems. Single-machine dynamic modeling, multi-machine dynamic modeling, network differential-algebraic equations and solution methods, small-signal stability analysis, and design of power system stabilizers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5314

Corequisite(s):

ECE 6504:

Advanced Topics in Computer Engineering

Advanced topics of current interest in computer engineering which are taken from current research topics and/or technical publications. Prerequisites at 5000 level dependent on specific topics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 6524 (AOE 5754) (ME 5554):

Deep Learning

Advanced concepts in Machine Learning and Deep Learning. Models (multi-layer perceptrons, convolutional neural networks, memory networks), learning algorithms (backpropagation, stochastic sub-gradient descent, dropout), connections to structured predictions (Boltzmann machines, unrolled belief propagation), and applications to perception and Artificial Intelligence (AI) problems (image classification, detection, and segmentation; image captioning; visual question answering; automatic game playing).

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5424 (UG) OR ECE 5424G (UG) OR CS 5824 (UG)

Corequisite(s):

ECE 6554:

Advanced Computer Vision

Current and state-of-the-art trends in computer vision, particularly in object recognition and scene understanding. Application of approaches in computer vision to various automatic perception problems. Strengths and weaknesses of computer vision techniques. Open questions and future research directions. Pre: 5554.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5554

Corequisite(s):

ECE 6564 (CS 6564):

Multimedia Networking

This course examines and explores recent advances in multimedia networking technologies. Major topics include multimedia compression and standards, quality of service (QoS) support mechanisms and protocols, performance analysis, network calculus, IP multicasting, Internet multimedia applications, and multimedia transport over wireless networks.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5565 (UG) OR ECE 5565

Corequisite(s):

ECE 6604:

Advanded Topics in Communications

Advanced topics of current interest in communications, which are taken from publications and industrial information.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5654 OR ECE 5655

Corequisite(s):

ECE 6634:

Multi-Channel Communications

In-depth study of modern multi-channel communications techniques, primarily multi-antenna systems (known as multiple input multiple output or MIMO) and Orthogonal Frequency Division Multiplexing (OFDM). Specifically the course examines multi-antenna techniques such as transmit and receive diversity, beamforming (including eigen-beamforming), and spatial multiplexing. Within the area of OFDM we examine modulation/demodulation, carrier bit loading, mitigating multipath, frequency-domain equalization, peak to average power reduction, and frequency offset mitigation. As time permits we will also investigate a third multi-channel technique known as multi-user scheduling or packet access networks.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5605, ECE 5654

Corequisite(s):

ECE 6744 (AOE 6744) (ME 6544):

Linear Control Theory

Advanced introduction to the theory of optimal control of time-varying and time-invariant linear systems; Solutions to the linear-quadratic regulator, optimal filtering, and linear-quadratic-gaussian problems; Robustness analysis and techniques to enhance robustness of controllers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5744 OR ECE 5754 OR ME 5544 OR ME 5554 OR AOE 5744 OR AOE 5754

Corequisite(s):

ECE 6774 (ISE 6574) (AOE 6774) (ME 6574):

Adaptive Control Systems

Introduction to the theory and methodology used to design adaptive controllers for uncertain systems, addressing issue such as input constraints, disturbance rejection, partial measurements, and robustness.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)

Corequisite(s):

ECE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

COMPUTER SCIENCE & APPLICATIONS

Calvin Ribbens, Head

Emeriti Faculty: James Arthur; Roger Ehrich; Steven Harrison; Hillyard Hartson; Barbara Ryder; Francisco Servant Cortes; Deborah Tatar;

Professors: Osman Balci; Douglas Bowman; Ali Butt; Kirk Cameron; Ing Ray Chen; Stephen Edwards; Wu-Chun Feng; Edward Fox; Lenwood Heath; Dennis Kafura; Benjamin Knapp; Wenjing Lou; Chang Tien Lu; T Murali; Dimitrios Nikolopoulos; Christopher North; Alexey Onufriev; Nicholas Polys; Narendran Ramakrishnan; Chandan Reddy; Calvin Ribbens; Adrian Sandu; Clifford Shaffer; Eli Tilevich; Layne Watson; Danfeng Yao;

Associate Professors: Godmar Back; Debswapna Bhattacharya; Young Cao; Jin-Hee Cho; Hoda Eldardiry; Denis Gracanin; Bo Ji; Aisling Kelliher; Kurt Luther; Donald McCrickard; Sharath Raghvendra; Liqing Zhang;

Assistant Professors: Dwayne Brown; Taejoong Chung; Brendan David-John; Peng Gao; Muhammad Ali Gulzar; Shaddi Hasan; Matthew Hicks; Thang Hoang; Lifu Huang; Xun Jian; Anuj Karpatne; Sang Won Lee; Ismini Lourentzou; Na Meng; Ha Rim Rho; Jamie Sikora; Christopher Thomas; Bimal Viswanath; Daniel Williams; Dawei Zhou;

Frank J. Maher Professor: Douglas Bowman;

Thomas L. Phillips Professor of Engineering: Narendran Ramakrishnan;

Elizabeth and James E. Turner, Jr. '56 Faculty Fellow; CACI Faculty Fellow: Danfeng Yao;

W.C. English Professor: Wenjing Lou;

Assistant Professor of Practice: Gregory Kulczycki;

Associate Professor of Practice: Margaret Ellis;

John W. Hancock, Jr Professor of Engineering: Dimitrios Nikolopoulos;

Instructors: Siwei Cao; Heath Hillman; David McPherson;

Research Professors: Mohammed Seyam;

Collegiate Associate Professors: Sally Hamouda; Sara Hooshangi; Reza Jafari;

Collegiate Assistant Professors: Kenneth Edmison; Onyeka Emebo; Andria Esakia; Mohammed Farghally; Tessema Mengistu;

Director of MEng:

Affiliate Professor in Computer Science:

Senior Research Scientist: Andrea Kavanaugh;

Research Scientists: Andrea Kavanaugh;

General Contact: gradprog@cs.vt.edu

Graduate Site: http://cs.vt.edu/Graduate.html

The graduate program at the Department of Computer Science at Virginia Tech is poised to become one of the top programs in the country. #40 in the US News and World Report 2018 rankings for graduate CS programs, additional accolades include being ranked in the top 20 CS departments in US Colleges of Engineering by number of Ph.D. degrees awarded.

SPECIAL FACILITIES

Laboratories in the Department of Computer Science in Blacksburg are distributed across three buildings: McBryde Hall, Torgersen Hall, and the KnowledgeWorks II (KWII) building in the Corporate Research Center (CRC). The Department of Computer Science at NCR is housed at the Virginia Tech NCR building in Falls Church and VTRC building in Arlington.

Bioinformatics Lab

The bioinformatics group on campus hosts and maintains several dedicated resources. The Expresso database server provides over 2TB of storage and is accessible to any of our research workstations & servers via our internal Gig-E network. Baobab is a 6 node Gig-E research cluster with 8 processor cores & 32GB of memory per node. Mnemosyne and Mnemosyne2 are high memory dedicated servers for intense memory usage calculations and is used by graduate and faculty researchers for large dataset manipulation. Kuprin is a NVidia cuda GPU processor machine using triple nVidia GTX680 cards.

Center for Human-Computer Interaction (CHCI)

Many Computer Science faculty and students are affiliated with the Center for Human-Computer Interaction (CHCI; hci.vt.edu), an interdisciplinary community of scholars focusing on human aspects of computing—understanding and designing for human use of interactive systems. Current CHCI research is focused on 3D Experiences (virtual reality, augmented reality, and visualization) and Social Informatics. Faculty and students affiliated with CHCI have access to a wide variety of resources for research, including the Cube (large motion-capture and spatial audio theater in the Moss Arts Center), the Visionarium (visualization facility including a four-wall CAVE system), a 3D Experiences Studio in the Moss Arts Center, additional design studios in the Media Building and Moss Arts Center, usability laboratories in McBryde Hall, and project rooms in VT KnowledgeWorks II. The CHCI maintains an inventory of shared mobile equipment (cameras, tablets, input devices, eye trackers, etc.) that can be reserved and checked out by affiliated faculty and students.

Discovery Analytics Center (DAC)

The Discovery Analytics Center (DAC; http://dac.cs.vt.edu) is an interdisciplinary research center at Virginia Tech with labs and facilities across the commonwealth in Blacksburg, Falls Church, and Arlington. The center's focus is on data analytics and machine learning to tackle knowledge discovery problems in important areas of national interest, such as intelligence analysis, sustainability, and public health. DAC currently is comprised of 16 academic faculty members, 6 research and professional faculty and over 90 Ph.D. students from computer science, statistics, electrical and computer engineering, and mathematics. DAC administers the graduate certificate in data analytics and the graduate certificate in urban computing. Our curriculum emphasizes not just the algorithmic aspects of converting data to knowledge but also the importance of human-in-the-loop analytics to arrive at insights. DAC researchers have access to high-performance computing facilities for big data analytics (including clusters and GPU machines), large-screen visualization displays and, most importantly, a variety of massive datasets collected in real-world contexts (e.g., social media, transportation, publishing, and real estate).

General Departmental Resources

The department maintains a pool of highly available virtualized servers to support email, web, and file services. Computer Science resources available to graduate students include: an @cs.vt.edu email address, a personal web site, and central file storage. Additional resources are available for research and instruction. Resources available for research include: virtualized servers, web site space, and backups. Resources available for instruction include: IaaS (infrastructure as a service), web site space, and a remote login cluster. Various research groups also offer special-purpose facilities to their members.

Human-Centered Design

Human-Centered Design An introduction to human-centered design benefits your graduate research and broadens your career prospects. Whether studying to be a designer, engineer, scientist or artist, your work ultimately impacts real people. Taking users seriously improves how projects are conceived and executed. Design matters. The act of creating something new shows up in many human endeavors. It can be a solution to a mundane problem like holding sheets of paper together or something as complex as the formulation of new institutions. Human Centered Design (HCD) is an approach to design charged with understanding the needs, wants, and limitations of end-users. This is accomplished through methodologies and practices where these considerations are integrated at every stage of the design process. In the Certificate program, students learn the core ideas of HCD, explore how it applies in their own professional domains, and discover how their own research connects with projects in other disciplines. In particular, it leverages inter-disciplinarity to see how to learn from the world around. The ability to collaborate across disciplines is a high-demand skill set in the private and public sectors and higher education careers, because institutions recognize that creative solutions to the most important societal challenges requires integrating aesthetics, analysis, and technological development. CO-Director of HCD- Ico Bukvic ico@vt.eduHow to Apply:Fill out the online application for participation in the certificate program.

Laboratory for Advanced Scientific Computing and Applications (LASCA)

The goal of the Laboratory for Advanced Scientific Computing and Applications (LASCA) is to provide expertise and leadership in high-end scientific computing research and education at Virginia Tech. Located in Torgersen Hall, the laboratory is a visible and strategic center of activity in applied high-performance computing on campus. LASCA participants do basic research in high-performance parallel computation and assist scientists and engineers in applying high-end computing resources to their problems. By bringing together experts in scientific computing and its applications, LASCA helps build the kind of multidisciplinary teams needed to address today's most challenging computational science problems.

stack@cs Center for Computing Systems

The stack@cs Center for Computer Systems (http://stack.cs.vt.edu) tackles challenging problems that transcend any single component of the application software and architecture stack and require interdisciplinary solutions. This requires the collaborative expertise of computer scientists and engineers, domain scientists, and educators spanning multiple departments across the College of Engineering and the College of Science as well as other research organizations such as ICAT and ICTAS. stack@cs Center faculty have a rich history of interdisciplinary collaborations that contribute to the evolving education and research missions of the college and university.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (577.0)

iBT: (90.0)

IELTS: (6.5)

The Master of Science degree provides a solid foundation in computer science while still offering flexibility to meet the needs and interests of individual students. The MS Thesis option requires 30 credits of course work of which typically 21 credits must derive from graded courses. Students in good standing typically complete this option in two years. Students taking a terminal MS degree are expected to complete the thesis. The MS coursework-only option is intended for PhD students who seek a "MS along-the-way". Students who wish a coursework-only degree at the Master's level should enroll in the MENG degree program. The MS thesis option requires 30 credits of course work of which typically 21-24 credits derive from courses and 6-9 credits from research work. At least one advanced graduate course must be included on the plan of study. Students must satisfy the breadth requirement by taking CS courses at the 5000 and 6000 levels that span four (4) different areas, adhere to an appropriate credit distribution, complete the graduate seminar twice, comply with the ethics and diversity requirements by completing either CS5014 or CS5024, and complete an oral and written final exam (also known as a Master's Thesis). Students in good standing typically complete the degree option in two years.The Computer Science department offers the accelerated BS/MS degree programs in accordance to graduate school polices and the following criteria. Students must be accepted into the program prior to the beginning of the semester in which they would enroll in courses to be used on the accelerated program. Students qualifying for the program must be in the last 12 months of their undergraduate degree and must have a minimum GPA of 3.5. Once completion of the undergraduate degree has been verified, students accepted into this accelerated program will be classified as regular graduate students. A maximum of 12 credits of graded coursework may be used in the program. No more than 6 of the double-counted credits may be at the 4000 level; all others must be offered for graduate credit. A grade of B or higher must be earned in each course to be double counted. Courses must not be taken pass-fail if a graded option is available.

Degree Concentrations:

Bioinformatics Option

Students receiving the option will have that fact noted on their transcript upon successful graduation. To receive the option, students will take a minimum of seven (7) additional credits beyond those necessary for the degree without the option. Other requirements include: Students receiving the Bioinformatics option must take PPWS 5314 Biological Paradigms for Bioinformatics (3 credits), BCHM 5024 Computational Biochemistry for Bioinformatics (3 credits), and GBCB 5004 Seminar (1 credit). PPWS 5314, BCHM 5024, and GBCB 5004 may not be used both to complete the option and to satisfy CSA degree course requirements. Students who already have background equivalent to PPWS 5314 and/or BCHM 5024 may be permitted to substitute more advanced courses to satisfy this requirement. Students receiving the Bioinformatics option must take ONE of STAT 5615 (Statistics in Research), STAT 5616 (Statistics in Research), MATH 5515 (Modeling and Simulation of Biological Systems), or MATH 5516 (Modeling and Simulation of Biological Systems). These courses may also be used to fulfill CSA coursework requirements. Students must complete the final exam requirement for their respective CSA degree using a topic suitable for the Bioinformatics option. MS coursework-only students must take GBCB 5874 Problem Solving in Genetics, Bioinformatics, and Computational Biology, and use the final report from this course to satisfy their final exam requirement.

Graduate Certificate in Human-Computer Interaction

The Graduate Certificate in Human-Computer Interaction is administered by the Center for Human Computer Interaction and can be obtained in conjunction with either the M.S. or Ph.D. degree. Master's degree students complete 9 hours and doctoral students 15 hours of coursework for the certificate, where at least two of the courses taken must be outside the student's degree program requirements and outside the department. Students interested in the Graduate Certificate in Human-Computer Interaction should confer with the director of the Center for Human Computer Interaction prior to submitting a program of study to the Graduate School. to submitting a program of study to the Graduate School. (http://www.hci.vt.edu)

Human Centered Design Graduate Certificate

The act of creating something new shows up in many human endeavors. Human Centered Design (HCD) is an approach to design charged with understanding the needs, wants, and limitations of end-users which can be an important perspective for graduate research. The Human Centered Design graduate certificate combines technical expertise with critical inquiry to develop reflective practitioners equipped to meet vital human needs; it is based in the Interdisciplinary Graduate Education Program of the Graduate School. The HCD/IGEP degree is built around competencies in four core areas: (1) Interdisciplinary Research, (2) Design Studies, (3) Understanding People, and (4) Design Realization. Students learn the core ideas of HCD, explore how it applies in their own professional domains, and discover how their own research connects with projects in other disciplines. Ico Bukvic ico@vt.edu

Graduate Certificate In Data Analytics

The Graduate Certificate in Data Analytics prepares students for technical careers in big data analytics and data science. Students learn to develop new analytical methods and tools by integrating the computational, statistical, and engineering techniques that form the heart of big data analytics. The certificate is open to degree- and non-degree seeking students. Students complete four courses from an interdisciplinary selection, spanning Computer Science, Statistics, and Electrical and Computer Engineering. Details and checksheet are available at http://dac.cs.vt.edu/.

Graduate Certificate in Urban Computing

The Graduate Certificate in Urban Computing trains students in the latest methods in analyzing massive datasets to study key issues concerning urban populations. Students learn to apply methods in data analytics, computational modeling, and visualization. The certificate is open to degree- and non-degree seeking students. Students complete12 hours of coursework for the certificate from an interdisciplinary selection, spanning Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Mathematics, Population Health Sciences, Sociology, Statistics, and Urban Affairs and Planning. Details and checksheet are available at https://dac.cs.vt.edu/academics/urban-computing/.

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (577.0)

iBT: (90.0)

IELTS: (6.5)

A student pursuing the Ph.D. degree is expected to exhibit a comprehensive knowledge of a broad cross section of the computer science discipline and to contribute significant new knowledge to the discipline through the research contribution contained in the doctoral dissertation. A PhD student must complete a minimum of 90 credits of graduate study, of which at least 27 must derive from courses. The PhD program is intended to be completed in about five years from entering the graduate program with a BS degree in Computer Science or a related field, or about four years if the student already has an MS degree in Computer Science or a related field. To encourage Ph.D. graduates to exhibit sufficient breadth of computer science and its application areas, Ph.D. students must take CS courses spanning four (4) computer science different areas and one to three cognate (i.e., outside CS) courses. At least two 6000-level CS graduate courses must be included on the plan of study.

Degree Concentrations:

Bioinformatics Option

Students receiving the option will have that fact noted on their transcript upon successful graduation. To receive the option, students will take a minimum of seven (7) additional credits beyond those necessary for the degree without the option. Other requirements include: Students receiving the Bioinformatics option must take PPWS 5314 Biological Paradigms for Bioinformatics (3 credits), BCHM 5024 Computational Biochemistry for Bioinformatics (3 credits), and GBCB 5004 Seminar (1 credit). PPWS 5314, BCHM 5024, and GBCB 5004 may not be used both to complete the option and to satisfy CSA degree course requirements. Students who already have background equivalent to PPWS 5314 and/or BCHM 5024 may be permitted to substitute more advanced courses to satisfy this requirement. Students receiving the Bioinformatics option must take ONE of STAT 5615 (Statistics in Research), STAT 5616 (Statistics in Research), MATH 5515 (Modeling and Simulation of Biological Systems), or MATH 5516 (Modeling and Simulation of Biological Systems). These courses may also be used to fulfill CSA coursework requirements. Students must complete the final exam requirement for their respective CSA degree using a topic suitable for the Bioinformatics option. MS coursework-only students must take GBCB 5874 Problem Solving in Genetics, Bioinformatics, and Computational Biology, and use the final report from this course to satisfy their final exam requirement.

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Graduate Certificate in Data Analytics

The Graduate Certificate in Data Analytics prepares students for technical careers in big data analytics and data science. Students learn to develop new analytical methods and tools by integrating the computational, statistical, and engineering techniques that form the heart of big data analytics. The certificate is open to degree- and non-degree seeking students. Students complete four courses from an interdisciplinary selection, spanning Computer Science, Statistics, and Electrical and Computer Engineering. Details and checksheet are available at http://dac.cs.vt.edu/.

Graduate Certificate in Urban Computing

The Graduate Certificate in Urban Computing trains students in the latest methods in analyzing massive datasets to study key issues concerning urban populations. Students learn to apply methods in data analytics, computational modeling, and visualization. The certificate is open to degree- and non-degree seeking students. Students complete12 hours of coursework for the certificate from an interdisciplinary selection, spanning Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Mathematics, Population Health Sciences, Sociology, Statistics, and Urban Affairs and Planning. Details and checksheet are available at https://dac.cs.vt.edu/academics/urban-computing/.

MEng Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (577.0)

iBT: (90.0)

IELTS: (6.5)

The Master of Engineering (MEng) degree provides advanced training in Computer Science at the graduate level, with an emphasis on practical coursework that prepares students for a wide range of employment in the computing field. The MEng degree program is open to students with less formal Computer Science background, since it includes the coursework needed to prepare such students for more advanced Computer Science courses. The MEng degree has a single coursework-only option that requires 30 credits derived from graded courses. This includes a required course related to ethics in computing and a project-oriented Capstone course. Students are required to complete a cluster of three courses to ensure depth in some practical aspect of computing. Full-time students in good standing can typically complete the program in three academic terms.The Computer Science department offers the accelerated BS/MEng degree program in accordance to graduate school polices and the following criteria. Students must be accepted into the program prior to the beginning of the semester in which they would enroll in courses to be used on the accelerated program. Students qualifying for the program must be in the last 12 months of their undergraduate degree and must have a minimum GPA of 3.3. Once completion of the undergraduate degree has been verified, students accepted into this accelerated program will be classified as regular graduate students. A maximum of 12 credits of graded coursework may be used in the program. No more than 6 of the double-counted credits may be at the 4000 level; all others must be offered for graduate credit. A grade of B or higher must be earned in each course to be double counted. Courses must not be taken pass-fail if a graded option is available..

GRADUATE COURSES (CS)

CS 5014:

Research Methods in Computer Science

Preparation for research in computer science. Technical communication skills. Design and evaluation of experiments. The research process.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5024:

Ethics and Professionalism in Computer Science

Ethical implications and consequences of computing technology applied to algorithmic decision making, security, privacy, autonomous systems. Ethical frameworks and their application to relevant current topics. Formulating, reasoning, and communicating positions on ethical topics related to computing technology. Diversity and bias as it relates to information technology. Ethical conduct of research and development of intellectual property. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5040:

Intermediate Data Structures and Algorithm Analysis

Data structures and analysis of data structure and algorithm performance. Sorting, searching, hashing, and advanced tree structures and algorithms. File system organization and access methods. Course projects develop advanced problem-solving, design, and implementation skills. Pre: Graduate standing in Computer Science and an undergraduate second semester programming course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5044:

Object-Oriented Programming with Java

Object-oriented programming concepts and the Java programming language. The application of design strategies, notations, and patterns related to object-oriented systems. Techniques and libraries for developing applications related to the World Wide Web. Credit will not be given for both 2704 and 5044. Not for Computer Science major or minor credit; not for graduate credit for CSA or INFS programs. Pre: Proficiency in a high-level programming language (e.g., FORTRAN, C, C++, or Java) equivalent to 1044 and prior course work, practical training, or work experience related to developing computer software and systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5045:

Computation for the Data Sciences

Covers fundamentals of computer science and background in data sciences needed by graduate students without a computer science background. 5045: Programming language syntax and semantics for data science; abstraction and object-oriented programming; data structures; databases; visualization; ethics and data manipulation. 5046: Software engineering; data preprocessing; and machine learning. Pre: Graduate standing for 5045; 5045 for 5046.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5046:

Computation for the Data Sciences

Covers fundamentals of computer science and background in data sciences needed by graduate students without a computer science background. 5045: Programming language syntax and semantics for data science; abstraction and object-oriented programming; data structures; databases; visualization; ethics and data manipulation. 5046: Software engineering; data preprocessing; and machine learning. Pre: Graduate standing for 5045; 5045 for 5046.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5045

Corequisite(s):

CS 5054:

Programming Models for Big Data

Survey of computer science concepts and tools that enable efficient computational science and data analytics with big data. Ethical issues in computing. Data structure design and implementation. Analysis of data structure and algorithm performance. Introduction to high-performance computer architectures and parallel computation. Basic operating systems concepts that influence the performance of large-scale computational modeling and data analytics. Software tools for computational modeling. Co:5046 or 5525

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5045

Corequisite(s):

CS 5104:

Computability and Formal Languages

Formal theory of computability, the halting problem, models of computation, and Churchs thesis, and formal languages.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5034

Corequisite(s):

CS 5114:

Theory of Algorithms

Methods for constructing and analyzing algorithms. Measures of computational complexity, determination of efficient algorithms for a variety of problems such as searching, sorting and pattern matching. Geometric algorithms, mathematical algorithms, and theory of NP-completeness. Pre: Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 2604

Corequisite(s):

CS 5124:

Algorithms in Bioinformatics

Algorithms to solve problems found in biology, especially molecular biology. A variety of current problems in computational molecular biology will be introduced, investigated, analyzed for computational complexity, and solved with efficient algorithms, when feasible. A number of such problems will be shown to be intractable or other evidence of their difficulty will be presented. Pre: Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (CS 5046, PPWS 5314)

Corequisite(s):

CS 5204:

Operating Systems

Issues in the design and functioning of operating systems. Emphasis on synchronization of concurrent activity in both centralized and distributed systems. Deadlock, scheduling, performance analysis, operating system design, and memory systems including distributed file systems. Pre: Background in Operating Systems required and Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5214:

Modeling and Evaluation of Computer Systems

An overview of modeling, simulation, and performance evaluation of computer systems, i.e., operating systems, database management systems, office automation systems, etc. Fundamentals of modeling, the life cycle of a simulation study, workload characterization, random number and variate generation, procurement, measurement principles, software and hardware monitors, capacity planning, system and program tuning, and analytic modeling. Duplication of subject matter of 4214 and 4224. Maximum of 6 hours credit may be obtained from 4214, 4224, 5214. Pre: Graduate standing the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5234:

Advanced Parallel Computation

Survey of leading high-end computing systems and their programming environments. Advanced models of parallel computation. Mapping of parallel algorithms to architectures. Performance programming and tools for performance optimization on parallel systems. Execution environments and system software for large-scale parallel computing. Case studies of parallel applications. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 4234 (UG) OR CS 4234

Corequisite(s):

CS 5244:

Web Application Development

Languages and technologies needed to develop modern data- centric web applications. Commonly used protocols and standards. Client-side technologies such as HTML, CSS, and JavaScript; server-side technologies such as Servlets and JSP; and database access with SQL. Principles and technologies for web application architecture, electronic commerce, and web application security.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5044

Corequisite(s):

CS 5254:

Mobile Application Development

Languages and technologies needed to develop applications for modern mobile devices. Mobile infrastructure and devices. Interactive graphical user interfaces for mobile devices. Protocols and standards for using mobile device features such as sensors, networking, location, camera, and audio. Mobile app architecture, performance considerations, and asynchronous programming. Principles and technologies for mobile security.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5044

Corequisite(s):

CS 5264 (ECE 5414):

Advanced Linux Kernel Programming

Design and internal organization of the Linux operating system kernel. Kernel subsystems, boot process, memory management, process and thread model, scheduling, interrupt and exception handling, virtual file system and the concrete file system, block I/O and I/O scheduler, network stack, and device drivers. Modification of existing kernel code. Design, implementation, test, and evaluation of new kernel modules. Kernel and full software stack debugging techniques, and virtualization as an aid for operating system development and debug. Software engineering techniques to analyze, modify and run a large, complex open-source code base. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5304:

Translator Design and Construction

Fundamental theory of parsing and translation and practical applications of this theory. Lexical analysis, parsing techniques based on top-down (LL, Recursive Descent) and bottom-up (LR, Precedence), code generation, code optimization techniques, and runtime systems. Pre: Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5314:

Programming Languages

In depth investigation of the principles of programming systems, not necessarily restricted to programming languages, both from the point of view of the user and implementer. Algorithms of implementation, syntax and semantic specification systems, block structures and scope, data abstraction and aggregates, exception handling, concurrency, and applicative/functional/data-flow languages.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 3304 (UG) OR CS 3304

Corequisite(s):

CS 5424 (BIOL 5424) (GBCB 5424):

Computational Cell Biology

Use of mathematical models (nonlinear ordinary differential equations and stochastic processes) and simulation algorithms to explore the complex feedback circuits that control the behavior of living cells. Concepts and techniques from dynamical systems theory, bifurcation analysis, numerical methods, SBML (systems biology makeup language) and Matlab programming. Applications in gene regulatory networks, cell cycle control, circadian rhythms, cell signaling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MATH 5515

Corequisite(s):

CS 5465:

Numerical Analysis

A survey of the construction, analysis, and implementation of numerical algorithms in linear algebra, nonlinear equations and optimization, approximation by polynomials, quadrature, and ordinary differential equations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5466:

Numerical Analysis

A survey of the construction, analysis, and implementation of numerical algorithms in linear algebra, nonlinear equations and optimization, approximation by polynomials, quadrature, and ordinary differential equations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5474 (MATH 5474):

Finite Difference Methods for Partial Differential Equations

Finite difference methods for initial and boundary value problems for partial differential equations. Consistency, stability, convergence, dispersion, and dissipation. Methods for linear and nonlinear elliptic and parabolic equations, first- and second-order hyperbolic equations, and nonlinear conservation laws. Pre: Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5484 (MATH 5484):

Finite Element Methods for Partial Differential Equations

Weak formulations of boundary-value problems for elliptic partial differential equations. Finite element spaces. Approximation theory for finite element spaces. Error estimates. Effects of numerical integration and curved boundaries. Nonconforming methods. Concrete examples of the application of the finite element method. Efficient implementation strategies. Time dependent problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 3414 (UG) OR CS 3414

Corequisite(s):

CS 5485 (MATH 5485):

Numerical Analysis and Software

Presentation and analysis of numerical methods for solving common mathematical and physical problems. Methods of solving large sparse linear systems of equations, algebraic eigenvalue problems, and linear least squares problems. Numerical algorithms for solving constrained and unconstrained optimization problems. Numerical solutions of nonlinear algebraic systems. Convergence, error analysis. Hardware and software influences. Efficiency, accuracy, and reliability of software. Robust computer codes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (MATH 4445 (UG), MATH 4446 (UG)) OR (MATH 4445, MATH 4446)

Corequisite(s):

CS 5486 (MATH 5486):

Numerical Analysis and Software

Presentation and analysis of numerical methods for solving common mathematical and physical problems. Methods of solving large sparse linear systems of equations, algebraic eigenvalue problems, and linear least squares problems. Numerical algorithms for solving constrained and unconstrained optimization problems. Numerical solutions of nonlinear algebraic systems. Convergence, error analysis. Hardware and software influences. Efficiency, accuracy, and reliability of software. Robust computer codes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (MATH 4445 (UG), MATH 4446 (UG)) OR (MATH 4445, MATH 4446)

Corequisite(s):

CS 5504 (ECE 5504):

Computer Architecture

Advanced computer architectures, focusing on multiprocessor systems and the principles of their design. Parallel computer models, programming and interconnection network properties, principles of scaleable designs. Case studies and example applications of pipeline processors, interconnection networks, SIMD and MIMD processors.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 4504 (UG) OR CS 4504

Corequisite(s):

CS 5510 (ECE 5510):

Multiprocessor Programming

Principle and practice of multiprocessor programming. Illustration of multiprocessor programming principles through the classical mutual exclusion problem, correctness properties of concurrency (e.g., linearizability), shared memory properties (e.g. register constructions), and synchronization primitives for implementing concurrent data structures (e.g., consensus protocols). Illustration of multiprocessor programming practice through programming patterns such as spin locks, monitor locks, the work-stealing paradigm and barriers. Discussion of concurrent data structures (e.g., concurrent linked lists, queues, stacks, hash maps, skiplists) through synchronization patterns ranging from coarse-grained locking to fine-grained locking to lock-free structures atomic synchronization primitives, elimination, and transactional memory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4534 OR ECE 4550

Corequisite(s):

CS 5525 (STAT 5525):

Data Analytics

5525: Basic techniques in data analytics including the preparation and manipulation of data for analysis and the creation of data files from multiple and dissimilar sources. The data mining and knowledge discovery process. Overview of data mining algorithms in classification, clustering, association analysis, probabilistic modeling, and matrix decompositions. Detailed study of classification methods including tree-based methods, Bayesian methods, logistic regression, ensemble, bagging and boosting methods, neural network methods, use of support vectors and Bayesian networks. Detailed study of clustering methods including k-means, hierarchical and self-organizing map methods. Prerequisite: Graduate Standing required. 5526: Techniques in unsupervised and visualized learning in high dimension spaces. Theoretical, probabilistic, and applied aspects of data analytics. Methods include generalized linear models in high dimensional spaces, regularization, lasso and related methods, principal component regression (pca), tree methods, and random forests. Clustering methods including k-means, hierarchical clustering, biclustering, and model-based clustering will be thoroughly examined. Distance-based learning methods include multi dimensional scaling, the self organizing map, graphical/network models, and isomap. Supervised learning will consist of discriminant analyses, supervised pca, support vector machines, and kernel methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5526 (STAT 5526):

Data Analytics

5525: Basic techniques in data analytics including the preparation and manipulation of data for analysis and the creation of data files from multiple and dissimilar sources. The data mining and knowledge discovery process. Overview of data mining algorithms in classification, clustering, association analysis, probabilistic modeling, and matrix decompositions. Detailed study of classification methods including tree-based methods, Bayesian methods, logistic regression, ensemble, bagging and boosting methods, neural network methods, use of support vectors and Bayesian networks. Detailed study of clustering methods including k-means, hierarchical and self-organizing map methods. Prerequisite: Graduate Standing required. 5526: Techniques in unsupervised and visualized learning in high dimension spaces. Theoretical, probabilistic, and applied aspects of data analytics. Methods include generalized linear models in high dimensional spaces, regularization, lasso and related methods, principal component regression (pca), tree methods, and random forests. Clustering methods including k-means, hierarchical clustering, biclustering, and model-based clustering will be thoroughly examined. Distance-based learning methods include multi dimensional scaling, the self organizing map, graphical/network models, and isomap. Supervised learning will consist of discriminant analyses, supervised pca, support vector machines, and kernel methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5525 OR STAT 5525

Corequisite(s):

CS 5544 (ECE 5544):

Compiler Optimizations

Overview of compilation and compiler optimizations. Design and internal organization of the Low-Level Virtual Machine compiler infrastructure. Static Single Assignment. Data-flow analysis and techniques for reaching definitions, live variable analysis, and available expressions. Lattice theory and iterative algorithms for general frameworks. Non-separable dataflow analysis including constant propagation and folding, faint variable analysis, and points-to may/must analysis. Loop-invariant code motion and lazy code motion. Static Single Assignment construction and optimizations. Register allocation and coalescing. Pointer analysis using Anderson’s and Steensgaard’s algorithms, and liveness analysis of heap data. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5560 (ECE 5560):

Fundamentals of Info Security

Principles of information security and relevant mathematical concepts. Classical ciphers, relevant abstract algebra and number theory, symmetric-key ciphers, cipher modes of operation, and asymmetric-key ciphers. Cryptographic hash functions and message authentication codes. Elliptic curve cryptography and cryptosystems. Applications and standards relevant to network and computer security. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5565 (ECE 5565):

Network Architecture and Protocols

5565: Principles and concepts of networking and protocols, with emphasis on data link, network, and transport protocols. Contemporary and emerging networks and protocols to illustrate concepts and to provide insight into practical networks including the Internet. Quantitative and qualitative comparisons of network architectures and protocols. 5566: Performance evaluation, design, and management of networks. Use of queuing and other analytical methods, simulation, and experimental methods to evaluate and design networks and protocols. Network management architectures and protocols. Graduate standing in EE, ECE, CS, or IT required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 4714 (UG) OR STAT 4714

Corequisite(s):

CS 5566 (ECE 5560):

Network Architecture and Protocols

5565: Principles and concepts of networking and protocols, with emphasis on data link, network, and transport protocols. Contemporary and emerging networks and protocols to illustrate concepts and to provide insight into practical networks including the Internet. Quantitative and qualitative comparisons of network architectures and protocols.

5566: Performance evaluation, design, and management of networks. Use of queuing and other analytical methods, simulation, and experimental methods to evaluate and design networks and protocols. Network management architectures and protocols. Graduate standing in EE, ECE, or IT is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5565 (UG) OR CS 5565

Corequisite(s):

CS 5580:

Cryptographic Engineering

Implementation of cryptographic operations and protocols in contemporary computing platforms. Mapping of cryptographic operations, evaluation and optimization of performance and implementation cost, analysis of security against brute- force cryptanalysis and implementation-level attacks. Design of countermeasures against implementation-level attacks, security-testing procedures, and architectures to support a trusted computing base.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5560 OR CS 5560

Corequisite(s):

CS 5584 (ECE 5584):

Network Security

Fundamentals of network security. Network security architecture, user and attacker perspective. Practical applications and security standards. Protocol design principles and their impact on computer and network security. Authentication systems. Email security. Firewalls and intrusion detection. Security for wireless systems. Pre: Graduate standing in CSA.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5590 (ECE 5590):

System and Software Security

Secure software design, memory and file system security, operating system security for various platforms. Program classification, anomaly detection, malware detection and analysis. Technical challenges and problems in securing operating systems and software. Classic and modern algorithms, models, principles, and tools for system and application software security. Actual security examples.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5560 OR ECE 5560

Corequisite(s):

CS 5594:

Blockchain Technologies

Principles of an open, distributed ledger. Underlying data structures and algorithms such as cryptographic hashing and Merkle trees, consensus algorithms, and Byzantine agreement. Bitcoin as an exemplar. Proof of work and proof of stake. Applications including cryptocurrencies, financial ledgers, and smart contracts. Pre: Graduate standing in Computer Science.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5604:

Information Storage and Retrieval

Analyzing, indexing, representing, storing, searching, retrieving, processing and presenting information and documents using fully automatic systems. The information may be in the form of text, hypertext, multimedia, or hypermedia. The systems are based on various models, e.g., Boolean logic, fuzzy logic, probability theory, etc., and they are implemented using inverted files, relational thesauri, special hardware, and other approaches. Evaluation of the systems efficiency and effectiveness. Pre: Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5614:

Database Management Systems

Emphasizes concepts, data models, mechanisms, and language aspects concerned with the definition, organization, and manipulation of data at a logical level. Concentrates on relational model, along with introduction to design of relational systems using Entity-relationship modeling. Functional dependencies and normalization of relations. Query languages, relational algebra, Datalog, and SQL. Query processing, logic and databases, physical database tuning. Concurrency control, OLTP, active and rule-based elements. Data Warehousing, OLAP. Pre: Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5644:

Machine Learning with Big Data

Basic principles and techniques for big data analytics, including methods for storing, searching, retrieving, and processing large datasets; introduction to basic machine learning libraries for analyzing large datasets; data visualization; case studies with real-world datasets. Not for graduate credit for degrees for MS and PhD degrees in Computer Science and Applications (CSA); MEng degrees in CSA allowed to receive credit.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5044

Corequisite(s):

CS 5664:

Social Media Analytics

Social media platforms, media feeds, and data formats; machine learning and graph theory foundations of social media analytics; Forms of social media analytics - text analytics, network analytics, and action analytics; Forecasting models and applications, including in marketing, event tracking, surveying, and A/B testing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5644

Corequisite(s):

CS 5704:

Software Engineering

Study of the principles and tools applicable to the methodical construction and controlled evolution of complex software systems. All phases of the life cycle are presented; particular attention focuses on the design, testing, and maintenance phases. Introduction to software project management. Attention to measurement models of the software process and product which allow quantitative assessment of cost, reliability, and complexity of software systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5044

Corequisite(s):

CS 5714 (ISE 5714):

Usability Engineering

Design and evaluation of effective user interfaces, beginning with principles for designing the product. Development process for user interaction separate from interactive software development. Development process includes iterative life cycle management, systems analysis, design, usability specifications, design representation techniques, prototyping, formative user-based evaluation. Integrative and cross-disciplinary approach with main emphasis on usability methods and the user interaction development process.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5724:

Models and Theories of Human-computer Interaction

Survey of models and theories of users and their use of computer equipment; conditions of application for various approaches. Task analysis, task modeling, representations and notations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5734:

Social Computing and Computer-Supported Cooperative Work

Social computing and cooperative work situations. Design implementation, use and analysis of computing systems concerned with multiple users and stakeholders. Analytic practices and application of human behavior theories for social computing. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5744:

Software Design and Quality

This course focuses on critical aspects of the software lifecycle that have significant influence on the overall quality of the software system including techniques and approaches to software design, quantitative measurement and assessment of the system during implementation, testing, and maintenance, and the role of verification and validation in assuring software quality.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5704 (UG) OR CS 5704

Corequisite(s):

CS 5754:

Virtual Environments

Introduction to the theory and practice of three-dimensional virtual environments (VEs). 3D input and output devices, applications of VEs, 3D user interfaces and human-computer interaction, 3D graphics techniques for VEs, 3D modeling and level of detail, evaluation of VEs, VE software systems and standards, collaborative and distributed VEs. Includes hands-on experience with VE hardware and software.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5764:

Information Visualization

Examine computer-based strategies for interactive visual presentation of information that enable people to explore, discover, and learn from vast quantities of data. Learn to analyze, design, develop, and evaluate new visualizations and tools. Discuss design principles, interaction strategies, information types, and experimental results. Research-oriented course surveys current literature, and group projects contribute to the state of the art. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5774:

User Interface Software

Survey of software architectures to build user interfaces, particularly focused on graphical user interfaces. Includes the design and implementation of user interfaces, the use of object-oriented application frameworks, software architecture for command undo, document management, layout managers, customized components, and separation of concerns in user interface software architectures. Discussion of research and advanced topics in User Interface Software.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): 1L, Lecture, Online Lecture

Instruction Type(s): 1L, Lecture, Online Lecture

Prerequisite(s): CS 2704 (UG) OR CS 2704

Corequisite(s):

CS 5804:

Introduction to Artificial Intelligence

A graduate level overview of the areas of search, knowledge representation, logic and deduction, learning, planning, and artificial intelligence applications. Pre: Graduate standing in the CSA program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5814:

Introduction to Deep Learning

History and basic concepts of artificial neural networks. Activation functions, optimization methods and regularization strategies used in deep multi-layered networks. Network architectures such as convolutional networks and recurrent neural networks. Deep reinforcement learning algorithms including deep Q-learning and policy gradient methods. Deep unsupervised models such as auto-encoders, and deep generative models including variational auto-encoders and generative adversarial networks. Encoder-decoder architectures and their applications in real-world problems such as machine translation, image captioning, visual question answering, and text summarization. Duplicates ECE 6524 (CS 6524).

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5525 OR STAT 5525 OR CS 5824 OR ECE 5424

Corequisite(s):

CS 5834:

Introduction to Urban Computing

Computational approaches to address urban challenges; sensor network testbeds; algorithms for storing, processing, and mining data from urban settings; communicating patterns to decision makers; special focus on epidemiology, sustainability, transportation, social science, urban economics; case studies with applications. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5844 (ME 5824):

Algorithmic Human-Robot Interaction

Formalizing interaction between robots and humans. Developing learning and control algorithms that enable robots to seamlessly and intelligently collaborate with humans. Mathematical approaches to human-robot interaction, learning from demonstration, Bayesian inference, intent detection, safe and optimal control, assistive autonomy, and user study design. Students review and present existing literature, conduct a research project. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5854:

Computational Systems Biology

Phenomenological and data-driven models of molecular interaction networks. Applications of graph theory, discrete algorithms, data mining, and machine learning to the modeling and analysis of molecular interaction networks. Biological applications. Interaction between biological and computational disciplines in systems biology. Must have GBCB pre-requisite and CS pre-requisites or graduate standing in CSA or equivalent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 4104 (UG) OR CS 4104 OR CS 5046, GBCB 5314

Corequisite(s):

CS 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CS 5914:

Emerging Topics in Computer Science

Emerging topics in computer science. Covers contemporary and often rapidly changing topics from the theory, practice, or application of computing. May be repeated 2 times with different content for up to 9 credit hours. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5934:

Capstone Project

Design, implementation, and communication of a software system throughout the product lifecycle. Current software product development models. Product ideation, end-user and stakeholder analysis. Product development targeted to market need. Communication of design and goals. Use of appropriate development tools. Pre: Graduate standing in Computer Science.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5944:

Graduate Seminar

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

CS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CS 6104:

Advanced Topics in Theory of Computation

This course treats a specific, advanced topic of current research interest in the area of theory of computation. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be repeated with different content for a maximum of nine credit hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5104 (UG) OR CS 5114 (UG) OR CS 5104 OR CS 5114

Corequisite(s):

CS 6204:

Advanced Topics in Systems

This course treats a specific advanced topic of current research interest in the area of systems. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be repeated with different content for a maximum of nine credit hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5204 (UG) OR CS 5214 (UG) OR CS 5204 OR CS 5214

Corequisite(s):

CS 6304:

Advanced Topics in Languages and Translation

This course treats a specific advanced topic of current research interest in the area of languages and translation. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be repeated with different content for a maximum of nine credit hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5304 (UG) OR CS 5314 (UG) OR CS 5304 OR CS 5314

Corequisite(s):

CS 6404:

Advanced Topics in Mathematical Software

This course treats a specific advanced topic of current research interest in the area of mathematical software. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be

repeated with different content for a maximum of nine credit hours.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CS 5485 (UG) OR CS 5485
Corequisite(s):

CS 6424:

PGMs and Structured Prediction

Advanced concepts in machine learning. Probabilistic graphical models and structured output prediction. Directed models (Bayes Nets), undirected models (Markov/Conditional Random Fields), exact inference (junction tree), approximate inference (belief propagation, dual decomposition), parameter learning (MLE, MAP, EM, max-margin), structure learning.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5424G OR CS 5824
Corequisite(s):

CS 6444 (ME 6444) (AOE 6444):

Verification and Validation in Scientific Computing

Applicable to scientific and engineering models described by partial differential or integral equations. Software engineering, code verification, and the method of manufactured solutions for generating exact solutions. Estimation of numerical approximation errors in scientific computing. Design and execution of experiments for model validation and model accuracy assessment. Propagation of aleatory and epistemic uncertainty through models. Estimation of total prediction uncertainty in scientific computing simulations. Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CS 6504:

Advanced Topics in Computer Architecture

This course treats a specific advanced topic of current research interest in the area of architecture. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be repeated with different content for a maximum of nine credit hours.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CS 5515 (UG) OR CS 5516 (UG) OR CS 5515 OR CS 5516
Corequisite(s):

CS 6564 (ECE 6564):

Multimedia Networking

This course examines and explores recent advances in multimedia networking technologies. Major topics include multimedia compression and standards, quality of service (QoS) support mechanisms and protocols, performance analysis, network calculus, IP multicasting, Internet multimedia applications, and multimedia transport over wireless networks.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CS 5565 (UG) OR CS 5565
Corequisite(s):

CS 6604:

Advanced Topics in Data and Information

This course treats a specific advanced topic of current research interest in the area of data and information. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be repeated with different content for a maximum of nine credit hours.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CS 5604 (UG) OR CS 5614 (UG) OR CS 5604 OR CS 5614
Corequisite(s):

CS 6704:

Advanced Topics in Software Engineering

This course treats a specific advanced topic of current research interest in the area of software engineering. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be repeated with different content for a maximum of nine credit hours.
Credit Hour(s): 3
Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5704 (UG) OR CS 5714 (UG) OR CS 5704 OR CS 5714

Corequisite(s):

CS 6724:

Advanced Topics in Human-computer Interaction

Addresses a specific advanced topic of current research interest in the area of human-computer interaction (HCI). Research monographs and papers from the current literature will be used as a source of material too new yet to be in a textbook. Student participation in a seminar-style format. Each offering of this course will address a different subtopic area of HCI. May be repeated for credit.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5714 (UG) OR CS 5724 (UG) OR CS 5734 (UG) OR CS 5714 OR CS 5724 OR CS 5734

Corequisite(s):

CS 6804:

Advanced Topics in Intelligent Systems

This course treats a specific advanced topic of current research interest in the area of intelligent systems. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. May be repeated with different content for a maximum of nine credit hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5804 (UG) OR CS 5814 (UG) OR CS 5804 OR CS 5814

Corequisite(s):

CS 6814:

Science-Guided Machine Learning

Addresses specific advanced topics in science-guided machine learning (SGML). Seminal papers, book chapters, and recent developments in the field will be used as a source of material too new to yet be in a textbook. Detailed study of science-guided learning, science-guided model design, science-guided initialization, and hybrid-science-machine learning modeling. Student participation is in a seminar style format. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 6824:

Adv Topics Comp Biol & Bioinf

Addresses a specific advanced topic of current research interest in the area of computational biology and bioinformatics (CBB). Research monographs and papers from the current literature used as a source of material too new to be discussed in a textbook. Student participation in a seminar-style format. Each offering of this course will address a different subtopic area of CBB. May be repeated with different content for a maximum of 12 credit hours. Pre: Graduate standing; other prerequisites may apply.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CREATIVE TECHNOLOGIES

Ann-Marie Knoblauch, Head

Professors: Eric Standley;

Associate Professors: Samuel Blanchard; Michael Borowski; Meaghan Dee; Travis Head; Ann-Marie Knoblauch; Thomas Tucker; Rachel Weaver;

Assistant Professors: Meredith Drum; Zachary Duer; Nathan King; Amanda Lechner; Dajana Nedic; Rachael Paine; Anne Ronan;

Collegiate Assistant Professors: Lesley Duffield; Hiromi Okumura; Amelia Salisbury;

Collegiate Associate Professors: James Jewitt;

General Contact: rcallah@vt.edu

Graduate Contact: thomasjt@vt.edu

General Contact: amk@vt.edu

Creative Technologies MFA Program: http://www.sova.vt.edu/creative-technologies-mfa/

School of Visual Arts: http://www.sova.vt.edu/

The Master of Fine Arts (MFA) in Creative Technologies (CT) in the School of Visual Arts (SOVA) is a practice-focused, terminal degree program at the intersections of fine art, design, and technology. Graduate students within the two-year CT MFA are expected to prioritize the development of original visual fine artworks, supplemented by practice-based and intellectual research, with the support of dedicated faculty mentorship amidst a diverse community of MFA program peers. Our MFA program is fundamentally cross-disciplinary and equips students with the conceptual, technical, creative, and critical skills to be successful artists and leaders across a range of fields. MFA student practices reflect the individual and unique visual arts practice and research interests of each student. Approaches to investigation span a remarkable spectrum of visual arts inquiry, spanning sculpture, installation art, coding, virtual environments, 3D modeling, photogrammetry, interactivity, video art, projection mapping, photography, experimental animation, and a myriad of other unbounded intersecting creative modalities. The CT MFA is not a commercial media or design program. We do not support commercial support of fields such as VFX or animation. Rather, we facilitate experimental, expanded, and deepened creative practice across visual arts disciplines. Creative research trajectories for our MFA students may also be informed by other programs across the university at the intersection of the arts, design, humanities, media, sciences, engineering, and culture. Full-time enrolled MFA students will complete the program in four semesters or two full academic years. Semester to semester, 9-month GTA funding for MFA students is contingent upon their appropriate and continued academic, artistic, and assigned job-specific effort and merit. Funding may be revoked at any time if MFA students fail to achieve expected milestones or do not meet their outlined GTA duties. We do not provide funded GTA support to MFAs beyond the four semesters allocated for normal degree completion. Application Deadline Our program's standard application deadline is February 15 for Fall admission. We do not admit people to our program in the spring semester or during the summer or winter terms. We highly encourage interested applicants to contact program coordinators to resolve any uncertainties or questions before applying. Please refer to the School of Visual Arts MFA program website for more information, and here for additional specific application instructions.

SPECIAL FACILITIES

The School of Visual Arts facilities are located in several different buildings on the Virginia Tech Blacksburg Campus. The Armory Building (203 Draper Rd. NW) is home to the school's main office, gallery, and classrooms utilized for Drawing and the Foundations Programs. Located downtown, the Armory provides a lively intersection of the town and campus. The Armory Art Gallery is operated as an educational and outreach service of the University. Its exhibition calendar includes work by visiting artists, faculty, and students. Additional core facilities that support MFA courses and student work include the following: The Media Building, located centrally downtown, is occasionally utilized for School of Visual Arts classrooms and provides unique opportunities for collaboration and exhibition. The Creativity and Innovation District LLC Building is centrally located and adjacent to numerous other School of Visual Arts spaces. This building offers state-of-the-art seminar and studio classrooms for studio art courses as well as graduate critique events. Digital Arts and Animation Lab (DAAS) is centrally located on the first floor of the Newman Library. The lab contains a render farm as well as numerous computers configured with professional software to facilitate creative production across digital arts and media technologies. ICAT Box, (CTBOX) located adjacent to DAAS on the first floor of the Newman Library, this lab additionally contains computers and software as well as VR headsets and other equipment for immersive and interactive media development. Henderson Hall houses the offices of numerous SOVA faculty, classrooms for the Graphic Design program (undergraduate) and Art History, as well as classrooms utilized by the Creative Technologies program. Four Design (SOVA's undergraduate professional design internship program) is also located in Henderson. Equipment and Tools accessible to MFAs who have received permission and requisite training include items such as the following: 3D Laser Scanner Flatbed Scanners CNC Router 3D Printers Laser and Inkjet Printers Laser Cutters VR Headsets VR-Ready Computers HD and 4K Digital Projectors Plasma, HD and 4K Monitors DSLR and Digital Video Cameras 16mm Cameras Tripods, Lighting Kits, Projector Stands Digital Audio Recorders Media Players Soldering supplies Small electronics, sensors, microcontrollers College-level facilities include the Art + Architecture Library located in Cowgill Hall. Additionally, MFA students may be able to undertake research projects through ICAT, which can facilitate access to specialized equipment and production spaces. These include labs equipped and dedicated to innovative and experimental arts and technology research projects. Within ICAT, these labs include the Cube, Experience Studio, Sandbox, Learn Studio, Perform Studio, and Create Studio. All Virginia Tech students additionally have access to well-equipped public digital laboratories facilitated by the University Libraries, including the various Media Design Studios, which are spaces for all members of the Virginia Tech campus community to create or co-create various types of media, including video, audio, and other multimedia, and access or check out high-end technology. This suite of options includes: The Virtual Environments Studio (VR production) The 3D Design Studio (3D printing) The Data Viz Studio (a data visualization lab) The Fusion Studio (co-working/ brainstorming and prototyping space)

Facility Web Resources

See the links below regarding a range of facilities, classroom/lab spaces, and resources currently utilized by the School of Visual Arts at Virginia Tech.

DEGREES OFFERED

MFA Degree

Offered In (Blacksburg)

IELTS
TOEFL

Paper: (550.0)

iBT: (80.0)

The MFA in Creative Technologies is a full-time, two-year in-person MFA program. We do not facilitate part-time enrollment in this degree program. The MFA requires the accumulation of 60 graduate credit hours during four semesters of full-time enrollment (15 credits per semester). Graduate credit hours are distributed as follows:* 15 credit hours in applied graduate-level studio courses across SOVA 12 minimum additional credit hours in graduate-level studio courses or ART 5994 Research and Thesis. Students may supplement these credits with graduate-level courses in other departments, so long as these are pre-approved by advisors and appropriate to the student's area(s) of research 9 minimum credit hours in Art History/Theory courses, including ART 5854G Advanced Theories and Processes of Contemporary Art (3 credit hours). Ethics must be a required component of at least one of these courses. 9 credit hours in ART 5534 Graduate Art Critique or Graduate Studio / Seminar courses 12 credit hours in ART 5594 Research and Thesis *Note: MFA students may be required to take supplemental courses to strengthen their background in specific areas as determined necessary by MFA Program Director. These courses may not count towards the 60 hour Plan of Study, but may count toward full-time enrollment status. Additionally, The Creative Technologies MFA requires the development, completion, and successful defense of an original creative thesis and research project. The MFA student works closely with their MFA Thesis Committee during their final two semesters in the program, and the Thesis Committee oversees and assesses student efforts in this capacity. Note that the MFA Thesis committee must include at least three SOVA faculty, and any outside-department faculty committee members must be pre-approved by the MFA Program Director. The student's creative work is exhibited and defended during the last half of the student's final semester in the MFA program. The student must additionally complete and submit a written Electronic Thesis and Dissertation (ETD) before receiving approval from the Committee.

Degree Concentrations:

Rather than pre-defined curricular tracks, Creative Technologies MFA students work with their faculty and assigned Graduate Program Advisor(s) to develop an individualized Plan of Study. All continuing students enroll in Graduate Critique courses to better strengthen the development of the MFA community, along with facilitating opportunities for invaluable peer and faculty critique. They additionally enroll in a range of differing studio, history/theory, and research-driven courses that cumulatively support the actualization of each student's unique intellectual and artistic goals.

CREATIVE WRITING

Kelly Pender, Chair

Professors: Edward Falco; Nikki Giovanni; Lucinda Roy; James Vollmer;

Associate Professors: Jeffrey Mann; Khadijah Queen;

Assistant Professors: Evan Lavender-Smith;

University Distinguished Professor Emerita: Nikki Giovanni;

Alumni Distinguished Professor: Lucinda Roy;

Graduate Contact: mtrimmer@vt.edu

Graduate Contact: vollmer@vt.edu

General Contact: mfacw@vt.edu

Graduate Site: https://liberalarts.vt.edu/academics/graduate-programs/master-of-fine-arts-in-creative-writing.html

Graduate Site: www.vtcwmfa.com

The goal of MFA in Creative Writing is to immerse graduate students in a culture of productive creativity by doing the following: providing them with an opportunity to work in apprenticeship fashion with writing faculty; helping them to acquire a keen sense of the evolving landscape and the challenges in the field of creative writing; empowering them to create a dynamic learning community of writers in the heart of Southwest Virginia; and enabling them to develop the requisite skills they need in order to publish full-length collections of poetry and fiction. The program will also prepare students for teaching at the college-level.

SPECIAL FACILITIES

The Creative Writing program is located on the second, third and fourth floors of Shanks Hall.

Shanks Hall

The MFA program in Creative Writing is housed in the second, third and fourth floors of Shanks Hall. The main office for the English Department is 323 Shanks Hall. The Graduate Programs Coordinator, Sally Shupe, is located in 323A Shanks Hall. The office of the MFA Program Director, Carmen Gimenez Smith, is in 201 Shanks Hall.

DEGREES OFFERED

MFA Degree

Offered In (Blacksburg)

TOEFL

Paper: (620.0)

iBT: (90.0)

IELTS: (8.0)

The MFA in Creative Writing is designed to be completed in three years. Students may specialize in Fiction or Poetry. A minimum of 49 hours is required for this terminal degree. A series of creative writing workshops, courses in form and theory, new media writing, composition pedagogy, and literature and theory electives are designed for students wishing to pursue careers as writers or writer/scholars at the college level. Students also have the opportunity to work as editors on the minnesota review and The New River: a Journal of Digital Writing and Art. A creative thesis, a written final exam, and an oral defense are required.The 49 hours required for the degree must be distributed as follows:Creative Writing Workshops: 15 hours (6704/Fiction, 6714/Poetry, 6724/Playwriting, 6734/Creative Nonfiction, 6744/New Media Writing); at least 9 hours must be in the designated specialty; students are encouraged to explore other genres in 6 hours of workshops. Form and Theory Courses: 6 hours (5734/Form and Theory of Fiction, 5744/Form and Theory of Poetry).GTA Training and Composition Pedagogy: 3 hours.Creative Writing Pedagogy and Practicum: 3 hours.Graduate School GTA Training: 1 hour.Editing a Literary Journal (5774): 6 hours Graduate English courses: 9 hours; students may use an independent study in Editing a Digital Journal to help fulfill this requirement.Research & Thesis (5994): 6 hours; a book-length creative thesis (a collection of poetry; a collection of short stories, or a novel)

CROP AND SOIL ENVIRONMENTAL SCIENCES

Michael Evans, Head

Emeriti Faculty: Marcus Alley;

Professors: Azenegashe Abaye; Walter Daniels; Matthew Eick; Gregory Evanylo; John Fike; John Galbraith; James Goatley; Carl Griffey; Steven Hodges; David Holshouser; Rory Maguire; Mark Reiter; Mohammad Saghai-Maroof; Wade Thomason; Benjamin Tracy; Kang Xia;

Associate Professors: Brian Badgley; William Frame; Song Li; Ryan Stewart; Carol Wilkinson;

Assistant Professors: Philip Brown; John Reid; Nicholas Santantonio; Hasan Seyyedhasani; Sanaz Shafian; Meredith Steele; Bo Zhang;

Research Faculty: Thomas Reed;

Thomas B. Hutcheson Professor: Walter Daniels;

W.G. Wysor Professor: Carl Griffey;

General Contact: spesgradinfo@vt.edu

Graduate Site: https://spes.vt.edu/

Graduate programs in Crop and Soil Environmental Sciences (CSES) are part of the School of Plant & Environmental Sciences (SPES) and lead to both the M.S. (non-thesis and thesis options) and the Ph.D. degrees. The principal objective of graduate education programs is to educate students in advanced concepts and research methods in one or more subdisciplines of CSES and related programs. This is accomplished through courses and research that bridge the physical and biological sciences. Individually planned programs of study are developed to provide education and experience in the general areas of focus for the department: 1) agronomy, 2) crop breeding and genomics, and 3) environmental science of soil and water in intensively managed landscapes. Graduate study programs in CSES are interdisciplinary by nature.The School and CSES also manage a "Direct to Ph.D." program and participates in several interdisciplinary M.S. and Ph.D. programs.

SPECIAL FACILITIES

The department has modern and extensive laboratory and field facilities and equipment for many research and teaching applications of crop, soil and environmental sciences. SPES, CSES and allied departments have the equipment necessary for cutting-edge research on crop response to inputs and management, crop physiology, traditional and molecular breeding of crops, next-generation sequencing of plant and microbial genomes, computational biology, environmental quality of degraded ecosystems, impacts of land use on ecosystem services, fate and transport of contaminants in air, water, and soil; and bioavailability and transformations of nutrients in soil and water,

Overall facility summary

See our website at www.spes.vt.edu for information on our programs and facilities.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General: Verbal (150.0), Quantitative (150.0), Analytical (4.0)

Establishing a Committee - The major advisor and student will select an Advisory Committee no later than the end of the first semester of residence. The minimum number of members for the advisory committee are 3 for M.S. students, and 4 for Ph.D. students. The Ph.D. committee must have at least one member from outside the School. At this meeting, the committee will become familiar with the student's training, background, and research interests. The committee also will orient and advise the student regarding research and course-work. Plan of Study : Students are expected to present to their major advisor a draft Program of Study that meets all requirements. After review and approval by the major advisor, the Plan of Study must be reviewed and approved by all members of the students advisory committee. After approval, the Plan of Study is submitted to the Graduate School through the Student Administration Center in the School. It is the student's responsibility to see that the Plan Study is submitted to the Graduate School on time (prior to completing 12 credit hours toward the M.S. degree, and before completing 18 credit hours beyond the M.S. toward the Ph.D. degree). Changes to the Plan of Study must be approved by the advisory committee and submitted to the Graduate School through the Student Administration Center. Research Proposal - As research is initiated for a degree, a Research Proposal will be presented in writing and orally to the student's Advisory Committee. This proposal should include sections containing: (a) an abbreviated literature search; (b) clear and concise objectives; (c) proposed experimental procedures; and (4) data analysis and presentation procedures. The purpose of this requirement is to determine whether the research proposed is adequate to satisfy degree requirements and to assist the student in clarifying objectives and procedures. The time to present the proposal will be determined by the major advisor and the committee. Students are encouraged to begin this process as soon as possible in order to complete their studies in a timely manner and with minimal wasted efforts! Report on Research - Each graduate student will present an annual progress report to his/her Advisory Committee and other interested persons prior to the final examination. The purpose of such reports is to evaluate the research progress and make suggestions for modifications or additions to the research objectives or procedures. A one page summary evaluation of the annual report is to be provided to the Graduate Coordinator. Preparation of Theses/Dissertations or Non-Thesis M.S. Project Reports - The student, with the assistance of his or her major professor, has the responsibility for preparation of the thesis/dissertation/project report. While the Graduate School specifies certain formats, it leaves matters of style largely to departments, but urges that the style conform to the major professional or scientific journals in the student's area of interest. Therefore, the CSES program suggests that theses/dissertations/project reports follow the style of journals of the American Society of Agronomy, Soil Science Society of America, or other sources acceptable by the committee. Students may find that certain mechanical considerations for manuscripts will differ between journals and those specified by the Graduate School. Follow the Graduate Policies and Procedures in such cases. Preparation of the thesis/dissertation/project report in proper style will facilitate the preparation of manuscripts for publication. All theses and dissertations must be submitted to the Graduate School in electronic format. Seminars are given by the Graduate School each semester to familiarize students with the procedures needed to prepare the electronic submission. Students are expected to know these procedures and prepare the thesis or dissertation to meet all requirements.Each section of the thesis/dissertation/project report should be prepared to the satisfaction of the Major Professor before being given to the other members of the Advisory Committee for review. Each section is to be provided to the committee members as it is completed. All sections of the thesis/dissertation are to be reviewed by the committee at least 14 days prior to the examination. Students will provide the members of the Advisory Committee the complete and revised thesis/dissertation at least 7 days prior to the oral examination/defense. Even though each member of the Advisory Committee will have provided suggestions or requirements for revisions of the thesis/dissertation/project report prior to the final examination, some corrections or additions will always be necessary even following a successful final examination. The Graduate School generally allows a period of two weeks after the final examination to submit the final version of the thesis or dissertation. The final project report is submitted only to the Major Advisor and Advisory Committee. Foreign Language Requirement - The department does not require a foreign language for any degree.

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General: Verbal (150.0), Quantitative (150.0), Analytical (4.0)

Establishing a Committee - The major advisor and student will select an Advisory Committee no later than the end of the first semester of residence. The minimum number of members for the advisory committee are 3 for M.S. students, and 4 for Ph.D. students. The Ph.D. committee must have at least one member from outside the School. At this meeting, the committee will become familiar with the student's training, background, and research interests. The committee also will orient and advise the student regarding research and course-work. Plan of Study : Students are expected to present to their major advisor a draft Program of Study that meets all requirements. After review and approval by the major advisor, the Plan of Study must be reviewed and approved by all members of the students advisory committee. After approval, the Plan of Study is submitted to the Graduate School through the Student Administration Center in the School. It is the student's responsibility to see that the Plan Study is submitted to the Graduate School on time (prior to completing 12 credit hours toward the M.S. degree, and before completing 18 credit hours beyond the M.S. toward the Ph.D. degree. Changes to the Plan of Study must be approved by the advisory committee and submitted to the Graduate School through the Student Administration Center. Research Proposal - As research is initiated for a degree, a Research Proposal will be presented in writing and orally to the student's Advisory Committee. This proposal should include sections containing: (a) an abbreviated literature search; (b) clear and concise objectives; (c) proposed experimental procedures; and (4) data analysis and presentation procedures. The purpose of this requirement is to determine whether the research proposed is adequate to satisfy degree requirements and to assist the student in clarifying objectives and procedures. The time to present the proposal will be determined by the major advisor and the committee. Students are encouraged to begin this process as soon as possible in order to complete their studies in a timely manner and with minimal wasted efforts! Report on Research - Each graduate student will present an annual progress report to his/her Advisory Committee and other interested persons prior to the final examination. The purpose of such reports is to evaluate the research progress and make suggestions for modifications or additions to the research objectives or procedures. A one page summary evaluation of the annual report is to be provided to the Graduate Coordinator. Preparation of Theses/Dissertations or Non-Thesis M.S. Project Reports - The student, with the assistance of his or her major professor, has the responsibility for preparation of the thesis/dissertation/project report. While the Graduate School specifies certain formats, it leaves matters of style largely to departments, but urges that the style conform to the major professional or scientific journals in the student's area of interest. Therefore, the School suggests that theses/dissertations/project reports follow the style of journals of the American Society of Agronomy, Soil Science Society of America, or other sources acceptable by the committee. Students may find that certain mechanical considerations for manuscripts will differ between journals and those specified by the Graduate School. Follow the Graduate Policies and Procedures in such cases. Preparation of the thesis/dissertation/project report in proper style will facilitate the preparation of manuscripts for publication. All theses and dissertations must be submitted to the Graduate School in electronic format. Seminars are given by the Graduate School each semester to familiarize students with the procedures needed to prepare the electronic submission. Students are expected to know these procedures and prepare the thesis or dissertation to meet all requirements. Each section of the thesis/dissertation/project report should be prepared to the satisfaction of the Major Professor before being given to the other members of the Advisory Committee for review. Each section is to be provided to the committee members as it is completed. All sections of the thesis/dissertation are to be reviewed by the committee at least 14 days prior to the examination. Students will provide the members of the Advisory Committee the complete and revised thesis/dissertation at least 7 days prior to the oral examination/defense. Even though each member of the Advisory Committee will have provided suggestions or requirements for revisions of the thesis/dissertation/project report prior to the final examination, some corrections or additions will always be necessary even following a successful final examination. The Graduate School generally allows a period of two weeks after the final examination to submit the final version of the thesis or dissertation. The final project report is submitted only to the Major Advisor and Advisory Committee. Foreign Language Requirement - The department does not require a foreign language for any degree.

GRADUATE COURSES (CSES)

CSES 5044:

Modeling Managed Ecosystems and Complexity

Introduction to systems thinking, diverse approaches to problem framing and modeling in managed ecosystems, and system dynamics model development processes. Application of theory, formal problem articulation, model conceptualization and formalization, testing, and analysis for decision support in agriculture, urban, and disturbed ecosystems. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5064G:

Advanced Soil Microbiology

Soil microbes as determinants of plant growth, sustainable agricultural systems, and global nutrient cycles. Environmental controls of soil microbes and relationship to soil decomposition. Soil as a micro-habitat. Application to soil management and plant growth, plant-microbe mutualisms, probiotics, biocontrol, composting, ecosystem restoration, and disease suppression. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5114:

Soils for Professionals

Characterization of soils as a natural resource emphasizing their physical, chemical, mineralogical, and biological properties in relation to nutrient availability, fertility, plant growth, land-use management, waste application, soil and water quality, and food production. Calculations used in land-use management. Pre: One year of introductory biology and chemistry. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5124:

Topics in Soil Genesis

Topics in soil genesis of regional interest will be addressed. This is a one-week field course that will rotate each year among four regions in the northeastern United States. The regions are Virginia-Maryland, Pennsylvania-West Virginia, New York, and the New England states. This will provide students the opportunity to observe and study soils in the field over a much broader geographic area that otherwise is not possible in a conventional semester course. May be repeated.

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): CSES 4134 (UG) OR CSES 4134

Corequisite(s):

CSES 5144 (FREC 5144):

Watershed Hydrology

Physical concepts of hydrological processes that affect age, origin, cycling, and flowpaths of water within watersheds. Analysis of current and historical research methods. Hydrological science as an interdisciplinary topic. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5224:

Advanced Concepts in Precision Agriculture

Advanced applications of the core components and technologies used for integrated plant and environmental studies including Global Navigation Satellite Systems (GNSS), remote sensing technologies, Geographic Information Systems (GIS), soil sampling, yield monitoring, and analysis and decision-making systems applied for site specific management of production agriculture resources. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5304:

Advanced Plant Genetics and Breeding

Plant breeding theory and methodology for the improvement of argonomic and horticultural crops; genetic diversity; polyploidy; gene inheritance, expression, interaction, and stability; incompatibility; male sterility; haploidy; genetic engineering and transformation; parental selection, hybridization, and population development; breeding methods, genotypic and phenotypic line selection and evaluation; strategies for cultivar development including marker assisted selection and breeding for durable disease resistance. Graduate standing required.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5314:

Water Quality for Professionals

Global water resource sustainability and management. Current water quality policies. Physical, chemical, biological, and anthropogenic factors affecting water quality, fate and transport of contaminants in water. Approaches of water quality risk assessment. Water treatment and management technologies. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5324:

Blending Business and Environmental Principles

Relationship between environmental principles and business planning. Strategies and methods for practical application that are mutually supportive to both environmental and business goals. Methods to communicate environmental risks to stakeholder groups. Environmental ethics in business, environmental decision making, competitive advantage through sustainability, environmental law in practice, public engagement strategies, and linking environmental performance to business strategies . Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5344:

Advanced Crop Physiology

Physiological considerations in a crop community: light interception, gas exchange, water stress, flowering, and senescence; key metabolic processes that most directly affect yield: photosynthesis (C3 and C4), photorespiration, and N-metabolism; cropping systems as symbioses.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CSES 4344 (UG) OR CSES 4344

Corequisite(s):

CSES 5444:

Applied Agronomic Topics for the Mid-Atlantic

Current operational and applied issues related to agronomic crop production systems in the Mid-Atlantic region. Nutrient, soil and water, pest and crop management issues and associated best management practices. Preparation for national Certified Crop Advisor examination. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5524:

Advanced Drone Applications in Ag Systems

Unmanned Aerial Systems (UAS) or drones as an advanced remotely sensed technology to collect ultra-high spatial resolution images. Fundamental components of drones, sensors and platforms, UAS operational concepts and legal requirements, principles of drone data collection. Overview of data processing software and generation of land maps from drone photogrammetry. Image analysis to make recommendations for water, nutrient and pesticide applications. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5544:

Soil-plant-animal Interrelationships in Grasslands

The principles of plant competition and succession during the establishment and maintenance of herbaceous species and communities are interrelated to soil, biotic, and microclimatic factors and their interactions. Ecological and nutritional principles embodying plant and animal factor in the utilization of herbaceous plants by livestock are established. Research methodology in grassland systems is presented.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (CSES 4214 (UG), CSES 4544 (UG), ALS 3204 (UG)) OR (CSES 4214, CSES 4544, ALS 3204)

Corequisite(s):

CSES 5554:

Ecology of Grazing Land Systems

A multi-disciplinary, multi-institution, field course. Students travel through diverse ecosystems studying the components and functions of grazing lands. Attention is to: (a) how components and functions vary to ecoregion; (b) research needs, objectives, and techniques in soil-plant - animal research; (c) forage-livestock ecology and systems in crop-, pasture-, range-, and forestlands; (d) the role of forages in conservation, wildlife habitat, and sustainable agriculture; and (e) industries involved with forages and livestock. X grade applies.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): CSES 4544 (UG) OR CSES 5544 (UG) OR CSES 4544 OR CSES 5544

Corequisite(s):

CSES 5604:

Environmental Science Concepts for Professionals

Physical, chemical, and biological principles and processes that are central to human-environment interactions. Emphasizes air and water resources and the role of energy in human and natural systems. Major U.S. environmental legislation and regulations. Pre: Two semesters each of college chemistry and biology and one semester of economics. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5634:

Soil Chemistry

Chemical and colloidal properties of clays and organic matter in soil systems including ion exchange, retention and precipitation; soil acidity and salinity; mineral weathering and formation; oxidation-reduction reactions; trace and toxic elements, and organic pollutants in soils. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5744G:

Adv Managed Ecosys Serv & Sust

Interactions of climate, soils, and organisms within intensively managed ecosystems used to produce food, energy, water, recreation, and other essential ecosystem services. Models of ecosystem development, role of disturbance, application of ecological theory and concepts to agricultural, grassland, and urban/turf ecosystems. Regional and global significance in sustainable food systems, and global ecosystem assessment. Pre-requisite: Graduate Standing and knowledge of basic soil science required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5774:

Advanced Rehabilitation of Disturbed Lands

Advanced study of human disturbance of soils and landscapes and various remediation strategies. Global environmental impacts of coal and metal mining, mineral processing, highway-utility corridor development, and urbanization. Acid mine drainage and treatment, including use of artificial wetlands. Study tours and field project. May not be taken after CSES 4774 or CSES 5874. Graduate standing required.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): CSES 4124 (UG) OR CSES 4124 OR CSES 4134 (UG) OR CSES 4134 OR MINE 4544 (UG) OR MINE 4544

Corequisite(s):

CSES 5844:

Plant Genomics

Comprehensive overview of genomics and its applications. Topics include: molecular markers, map construction, map-based cloning, quantitative trait loci, and functional genomics. Even Years. Pre: Knowledge of general principles of genetics and molecular biology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CSES 4144 (UG) OR CSES 4144

Corequisite(s):

CSES 5854:

Advanced Wetland Soils

Wetlands soils as components of natural landscapes: biogeochemistry, hydrology, geomorphology, hydric soil indicators, and wetland functions under various land uses. Soil and hydrologic factors important to wetland delineation and jurisdictional determination. Mitigation of wetland impacts with emphasis on restoration and creation. Outdoor lectures at local wetlands and a two-day long field trip to observe and identify wetland soils are mandatory. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5864:

Advanced Wetland Soils and Mitigation

Wetland soils as components of natural landscapes and their interactions with hydrologic systems. Hydric soil identification and delineation, preparation of wetland water budgets, restoration of damaged wetlands, and creation of compensation wetlands. Utilization of advanced soil information systems and GIS/GPS in wetlands study. Constructed wetlands for nutrient removal and acid mine drainage treatment.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CSES 5114 (UG) OR CSES 5114

Corequisite(s):

CSES 5874:

Reclamation of Disturbed Lands

Human disturbances of soils and landscapes and various remediation strategies. Environmental impacts of coal and metal mining, mineral processing, highway or utility corridor development, and urbanization. Field and lab testing protocols; development of site-specific revegetation protocols. Acid mine drainage and treatment, including use of artificial wetlands.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CSES 5114

Corequisite(s):

CSES 5904:

Project and Report

Project for non-thesis Masters of Science degree option. To constitute 3 to 6 of the 30 credit hours required for the degree. This course will emphasize critical interpretation, review, and oral/written reporting of an assigned topic. Review grade only. May be repeated.

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CSES 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

CSES 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CSES 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CSES 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

DAIRY SCIENCE

David Gerrard, Interim Head

Professors: Mark Hanigan; Katharine Knowlton;

Associate Professors: Benjamin Corl; Kristy Daniels; Gonzalo Ferreira; Christina Petersson-Wolfe;

Assistant Professors: Rebecca Cockrum; Johan Osorio Estevez;

David R. and Margaret Lincicome Professor of Agriculture: Mark Hanigan;

Colonel Horace E. Alphin Professor: Katharine Knowlton;

Benjamin Corl: bcorl@vt.edu

Student Handbook: http://www.dasc.vt.edu

The Dairy Science Department recognizes the significant contributions made by graduate students to departmental research, teaching, and extension programs and is committed to providing the best possible opportunity for students to learn and develop as professionals in their areas of interest. Application Process The GRE exam is required for all applicants. The results of the Test of English as a Foreign Language (TOEFL) is required for applicants who did not receive their bachelor's degrees from an Anglophone university and whose first language is not English. We currently expect a minimum TOEFL score of 90 (IBT) or IELTS score of 6.5 for admission. Further, TOEFL scores of 20 or greater in Listening, Writing, Speaking, and Reading subsections are required. Three letters of recommendation are required. We strongly encourage applicants to have online recommendations completed. Applicants are asked to provide names and email addresses for each reference in the online application. If applicants choose to have paper letters of recommendation submitted, the letters should be sent to the attention of Becky Michael in the Dairy Science Department. It is expected that applicants should be near completion of a B.S. or M.S. degree in animal or dairy science, biology, microbiology, biochemistry, related biological fields, agricultural economics, or agricultural finance. Students should have a 3.0 GPA or greater and strong scientific writing and communication skills. Students are strongly encouraged to apply online. Applying online streamlines the application process and reduces processing time. Applicants must pay a $75 non-refundable fee. Terms of EmploymentMany graduate students in Dairy Science receive financial support in the form of a graduate research assistantship or graduate teaching assistantship. Since all students conduct research as a part of degree requirements and most students assist in some way with the teaching of classes, the Department of Dairy Science makes no meaningful distinction between graduate research and teaching assistantships. Some students are recipients of fellowships awarded through the College, University, or Graduate School, and a few are supported by their own funds or funds from their home country, in the case of some international students. Regardless of the source or amount of support, all graduate students are considered to be half time employees of the department. As such, graduate students are expected to work 20 hours per week (50 weeks per year with two weeks paid vacation) in support of departmental research, teaching, and/or extension programs. Much of this is related to the thesis or dissertation research conducted by all students and is heavily concentrated in the latter stages of a student's degree program. However, graduate students also are expected to contribute to departmental research projects, assist in classroom teaching, and participate in extension programs as requested by their faculty supervisors, to whom they are directly responsible. Participation in departmental research, teaching and extension activities serves not only to support departmental programs, but also to train students in areas important to eventual career success.

SPECIAL FACILITIES

The Department has laboratory and animal facilities to support its missions in teaching, research, and extension.

Laboratories

The Department resides in Litton Reaves Hall, a modern, well equipped, office building. In addition to offices, it includes extensive laboratory space with state of the art equipment and classroom facilities. Laboratories supporting physiology, molecular biology, nutrition, health, and quantitative research are included.

Virginia Tech Dairy

The Virginia Tech Dairy Science Complex is located at Kentland Farm. Lactating cows are housed in a 232 stall freestall barn where feed consumption can be monitored for research. The barn features drovers alleys on both sides and research pens on one side. It is double sloped to middle and utilizes sand bedding. The sand is recycled using a weeping wall system for manure management. The milking facility is designed for animal handling with a double 12 parallel parlor and houses administrative offices. There is also a special needs barn for use with weaned calves, breeding age heifers and close up dry cows. Additionally, there's a calf barn with automatic feeders and weaned calf pens. Facilities and equipment for research with all ages of animals are present at the farm and support both applied and basic research in the department.

DEGREES OFFERED

MSLFS Degree

Offered In (Blacksburg)

TOEFL

Paper: Minimum (577.0)

Computer: Minimum (233.0)

iBT: Minimum (90.0)

GRE

Average Scores of Candidates: Verbal (150.0), Quantitative (165.0), Analytic Writing (3.5)

Graduate Advisory Committee All students are assigned a faculty supervisor (major professor) prior to, or immediately after initial enrollment. Assignments should be mutually agreeable to both student and faculty member, and each faculty supervisor should have an active research program in the area of student interest. Within the first or second semesters of enrollment, each student should work with his/her faculty supervisor to establish an advisory committee (three members for MS committees; four for Ph.D. committees) to assist in the development of a program of study and completion of the thesis or dissertation research project. Advisory Committee members are expected to provide appropriate and timely input to the academic and research programs of the student. Conversely, both students and faculty supervisors are expected to assure appropriate involvement of the advisory committees in each student's program. Students should discuss any problems related to their advisory committee with their faculty supervisor and, if needed, with the department head.Credit Hour LoadsFull-time credit hour loads are 12 hours in Fall and Spring semesters (in addition to courses audited). Typically, students will register for 6 to 9 hours of formal course work (2 to 3 classes) during Fall and Spring terms (or less during the latter stages of a graduate program), and for sufficient hours of Research and Thesis (MS) or Research and Dissertation (PhD) credits to complete the 12-hour, full-time load. Note that this is required for payment of assistantships and for progression from assistantship step 1 to step 2, since step 2 requires the completion of 24 credit hours.Students who, prior to the beginning of a semester, will have 1) fulfilled all residency and course requirements 2) scheduled their final exam to take place by the Friday of the third week of classes and 3) submit a final thesis or dissertation to their committee during the first three weeks of the semester, are eligible to request registration for 1 hour as Start of Semester Defense Exception. A certification form, available from the departmental office, must be submitted to the Graduate School in order to be registered as Start of Semester Defense Exception . Registration may affect eligibility for assistantships and certain student benefits and/or loans since students so registered do not pay the comprehensive fee and are not classified as full-time students.Evaluation of Performance and Progress toward DegreeIn an effort to foster communications between graduate students, their faculty supervisors, and advisory committees, the Dairy Science Department requires an annual evaluation and communication of graduate student performance and progress toward either the M.S. or Ph.D. degree. The process is initiated with a written report, from each graduate student to his/her faculty supervisor, which appropriately details the graduate student's academic and research program progress during the preceding year. The form of the report is the prerogative of the faculty supervisor and due by February 1st of each year or earlier as designated by the faculty supervisor. In response, faculty supervisors write a letter by March 1st of each year which details the supervisor's evaluation of each graduate student's performance and progress toward a degree. Graduate students and faculty supervisors meet at an appropriate and convenient time to discuss the student's report and supervisor's evaluation, concentrating most especially on any differences in expectations or evaluation between the student and supervisor. Both the student's report and supervisor's letter will become a part of the student's file. It is expected that advisory committee members will be used appropriately to develop each student's academic program, in the planning and execution of the research project, and in contributing to the evaluation letter. A form that serves to more clearly define guidelines and requirements is available. Briefly, students must be registered for the minimum of three credits in the semester/summer they take an examination or when a degree is completed. If a dissertation is ready for defense by the beginning of a semester (See http://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html for the deadlines for each semester of the current year) the student may qualify for Defending Student Status (DSS, 1 credit; http://www.grads.vt.edu/graduate_catalog/poli/UIPo.jsp?p=11).The department has created a Graduate Student Progress Check List and the Annual Graduate Student Evaluation Form. These are included at the end of this document. Time Limits for Degree ProgramsGuidelines for time to complete graduate degree programs are established as departmental policy in the interest of both the department and student. As a general guideline, it is expected that MS programs will be completed within two years and that Doctoral programs will require no more than three years. Students receiving financial assistance are assured of continuing support for these periods of time. In the event that circumstances prevent completion of a degree within the prescribed time limit, it is the responsibility of the student's faculty supervisor to request or provide an extension of financial support.Annual Evaluation Guidelines There are two new forms that will become part of the student record in the department. The first is a DASC Graduate Student Checklist and the second is a DASC Annual Student Evaluation Form. Copies of these forms are also included at the end of this document. Copies of the forms (saved as word documents) are available on the Department website. The annual evaluation of graduate students provides an opportunity to insure that appropriate progress toward degree requirements is occurring and to allow for adjustments in the program of study, teaching activities, or research efforts. It is also important to keep the advisory committees informed. Evaluations occur in the Spring Semester (see above) - to meet pending graduate school requirements -- first evaluations may be brief. However, the following elements are expected to be part of the evaluation documentation as appropriate. Signatures of the Major Advisor and Committee Members (likely not applicable during your first evaluation cycle). Milestones accomplished - for example, filing of the program of study or scheduling of the preliminary exam (for a Ph.D. student). Documentation indicating that a regular meeting of the student advisory committee was held and a brief written summary of major conclusions from the meeting (may not apply with initial evaluations). List of publications. List of professional talks. Documentation of teaching activities. Listing of service activities. Awards and other honors. General academic progress - i.e. satisfactory progress in class work as well as research activities. Comments by the student Signature of Student - to indicate that her or she read and understands the document

GRADUATE COURSES (DASC)

DASC 5004:

Seminar

Reports and discussion of current research in dairy science. Required of DaSc graduate students. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

DASC 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

DASC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

DASC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

DASC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

DASC 6274:

Critical Thinking in Bovine Physiology and Metabolism

Framework for bovine physiology and metabolism research. Advanced examination of how gene products, nutrients, and other metabolites cooperatively influence bodily functions in cattle. Evaluation of experimental designs and analytic methods used in physiology and metabolism research. Application of critical thinking. Interpretation and appraisal of physiological and metabolic data. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

DATA ANALYSIS AND APPLIED STATISTICS

David Higdon, Head

Professors: Ronald Fricker; Robert Gramacy; Feng Guo; David Higdon; Ina Hoeschele; Yili Hong; John Morgan; Eric Smith; Gordon Vining;

Associate Professors: Xinwei Deng; Leanna House; Leah Johnson; Scott Leman; George Terrell; Xiaowei Wu; Hongxiao Zhu;

Assistant Professors: Jyotishka Datta; Christopher Franck; Meimei Liu; Xin Xing;

Associate Professor of Practice: Jennifer Van Mullekom;

Research Assistant Professors: Allison Tegge;

Senior Instructors: Anne Driscoll;

Professor of Practice: Alexandra Hanlon; Thomas Woteki;

Research Associate Professors: Laura Freeman;

Graduate Contact: epsmith@vt.edu

General Contact: chconne1@vt.edu

NCR Graduate Contact: drwo@vt.edu

NCR General Contact: crnelson@vt.edu

Graduate Site: https://www.stat.vt.edu/academics/graduate.html

Virginia Tech's Department of Statistics offers the Master of Arts in Data Analysis and Applied Statistics (DAAS) on the Blacksburg and Northern Virginia campuses. The DAAS curriculum provides a wide variety of applied statistical tools to students, without the emphasis on statistical theory steeped in mathematics. Core courses in the M.A. DAAS program emphasize the fundamentals of statistics. Students are then free to choose from a plan of electives in specialized topics in statistics. Thus, the degree offers sufficient depth in the fundamentals of contemporary applied statistical methods and gives students an understanding of how they are applied in different fields. At our Blacksburg campus, the M.A. DAAS degree is a simultaneous degree. Current Virginia Tech master's and/or Ph.D. students in another discipline, who desire to complement their training with the M.A. DAAS degree, are eligible to apply to the degree. The applied statistics emphasis of the M.A. DAAS will empower students to perform more statistically sophisticated research, improving the quality of their theses/dissertations, and leading to papers published in higher-level journals than would be possible without such courses. As part of our offerings in Blacksburg, this degree is co-sponsored by several other programs and departments. The co-sponsoring programs include the Education Research and Evaluation Program (EDRE) and the Genetics, Bioinformatics, and Computational Biology program and the co-sponsoring departments include the Departments of Agricultural and Applied Economics, Psychology, Fish and Wildlife Conservation, Forest Resources and Environmental Conservation, Geography, Economics, Human Development, Sociology, and Biological Sciences. The M.A. DAAS program is also offered at our Northern Virginia Campus as a part-time professional masters. The curriculum offers students a strong foundation in statistics and analytics so that they begin to extract meaningful insights from large data sets and harness their potential. The program is suited to all students, with particularly the working student in mind. Consequently, our semesters are a blend of an in-person class that is taught one evening per week and one online course.

SPECIAL FACILITIES

The Blacksburg department has several laboratories housing state-of-the-art Linux and PC networks. Students have access to these for collaboration, course work, and research. Students gain extensive experience with modern statistical software for experimental design, data management and analysis, and computer programming for statistical purposes.

Department of Statistics

The Department of Statistics at the Blacksburg campus has several laboratories housing state-of-the-art Linux and PC networks. Students have access to these for collaboration, course work, and research. Students gain extensive experience with modern statistical software for experimental design, data management and analysis, and computer programming for statistical purposes. The Falls Church campus has an available library and study area and is conveniently located near the West Falls Falls Church metro station and I-66. Parking is available to students.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg, National Capital Region)

The Master of Arts in Data Analysis and Applied Statistics degree comprises 30 credits, distributed among applied statistics and analytical courses from a variety of departments. The core program will consist of courses comprising 18 credit hours in applied statistics, regression methods, design of experiments, basic professional development in communication and collaboration, and a final project and examination required of all students. The remaining 12 credit hours are from electives from the Department of Statistics and/or other departments. The core curriculum consists of 18 credit hours in courses from the Statistics department: STAT 5024: Communication in Statistical Collaborations (3 cr) STAT 5204G: Experimental Design: Concepts and Applications (3 cr) STAT 5214G: Advanced Methods of Regression Analysis (3 cr) STAT 5615/5616: Statistics in Research I and II (6 cr) STAT 5904: Project and Report (3 cr)

DISASTER RESILIENCE

Professors: Jennifer Irish; Marie Paretti; Robert Weiss; Christopher Zobel;

Associate Professors: Margaret Cowell; Yang Zhang;

R.B. Pamplin Professor of Business Information Technology: Christopher Zobel;

General Contact: czobel@vt.edu

Graduate Site: http://www.czobel.bit.vt.edu/resilience-igep/index.html

Interdisciplinary efforts to build resilience to disasters have not succeeded as desired. Although we now have better models, better technology and better communication, our vulnerability to disaster and risks continues to grow. One of the key reasons for this is the way we live. Concentrations of people, power, technology, education, and knowledge lower resilience and create more complex connections that can be disrupted. Virginia Tech's Interdisciplinary Graduate Education Program in Disaster Resilience is working to improve disaster resilience and sustainability by changing the interdisciplinary paradigm. Instead of feeding information and experience into a core of knowledge, the Disaster Resilience IGEP's goal is to have the disaster perspective inform the disciplines. We are tapping the power of scenarios to create a shared experience among many disciplines. This experience will help shape a perspective of resilience that informs everyday decisions in widely distributed activities. The primary goal of our collaborative effort is to prepare graduate students to become thought leaders in promoting resilience concerns in a wide variety of disciplines. Focusing on the trans-disciplinary paradigm, our effort leverages the strengths of several world-class academic units at Virginia Tech to produce a well-rounded perspective and understanding of the full complexity of disaster risk, resilience, and mitigation. Our approach concentrates on investigating the main drivers of vulnerabilities, recognizing their complex interactions, and generating informed risk minimization strategies. The current departments and colleges at Virginia Tech from which the core faculty in the program are as follows: Business Information Technology (in the College of Business) Civil and Environmental Engineering (in the College of Engineering) Geosciences (in the College of Science) Urban Affairs & Planning (in the College of Architecture and Urban Studies) Engineering Education (in the College of Engineering) New students can be admitted directly into the Interdisciplinary Graduate Education Program in Disaster Resilience, but they will transition into one of the participating academic departments for their core coursework and degree completion, while continuing to participate in Program activities. The Disaster Resilience program does not currently offer a dedicated graduate degree.

SPECIAL FACILITIES

DR IGEP facilities correspond to those available to each of the faculty members in their home departments.

DEGREES OFFERED

IGEP Degree

The Interdisciplinary Graduate Education Program in Disaster Resilience does not currently offer a dedicated graduate degree. Participants will participate in interdisciplinary program activities such as seminars and workshops, but will work towards receiving a PhD degree from one of the following core participating departments: Business Information Technology (in the College of Business) Civil and Environmental Engineering (in the College of Engineering) Geosciences (in the College of Science) Urban Affairs & Planning (in the College of Architecture and Urban Studies)

ECONOMICS

Sudipta Sarangi, Head
Niloy Bose, Interim Head

Emeriti Faculty: Amoz Kats;

Professors: Richard Ashley; Sheryl Ball; Niloy Bose; Suqin Ge; Hans Haller; Djavad Salehi-Isfahani; Sudipta Sarangi; Aris Spanos; Thorwald Tideman;

Associate Professors: Richard Cothren; Adam Dominiak; Xu Lin; Kwok Tsang;

Assistant Professors: Sergio Barrera; Ali Habibnia; Shaowen Luo; Melinda Miller; Hector Tzavellas; Bo Zhou;

Wilson Schmidt Professor: Aris Spanos;

Advanced Instructors: Gebremeskel Gebremariam;

Collegiate Assistant Professors: Pitchayaporn Tantihkarnchana;

Collegiate Associate Professors: Jadrian Wooten;

General Contact: astanfor@vt.edu

Graduate Program Director: byront@vt.edu

Graduate Contact: wibebout@vt.edu

Graduate Program: https://www.econ.vt.edu/graduate

The Virginia Tech Economics program was established on September 1, 1961, and since then, it has awarded more than 200 doctoral degrees in economics. From 2000 onwards, the program has taken a new direction - while students still earn a doctorate in Economics, the program is jointly administered by the Department of Economics and the Department of Agricultural and Applied Economics, giving students access to a variety of courses. 1. Curriculum - The Ph.D. program is designed to be completed in 4-5 years, with the first two years focused on coursework and the remaining years on research and completion of the dissertation. Following a set of compulsory core courses in microeconomics, macroeconomics, and econometrics in the first two years, the students take more advanced and specialized field courses in areas like applied microeconomics (health, labor, and development economics), microeconomic theory, experimental and behavioral economics, econometrics, and macroeconomics. Students must pass a Qualifying Examination at the end of the first year and complete and defend a Third Year Research Paper before the end of their third year. Each student is expected to successfully defend a doctoral dissertation by the end of the fourth or fifth year in the program. 2. Career - The doctoral program in economics prepares students for research and teaching careers and careers in the public and private sectors that require knowledge and understanding of the most advanced economic theory and methods. Our recent graduates are well-placed nationally and internationally in academic institutions, finance and investment industries, and government sectors. 3. Faculty Research - The faculty members conduct research in diverse fields, including i) Microeconomic Theory & Game Theory, ii) Applied Microeconomics (Labor, Development, Industrial Organizations, and History), iii) Experimental & Behavioral Economics, iv) Econometrics, v) Resource & Environmental Economics, and vi) Macroeconomics and Finance. 4. What Sets Us Apart – The doctoral program in Economics is housed in the College of Science, focusing on integrating modern scientific techniques with economic reasoning to prepare students for the modern economy. Besides conducting research in core subject areas, the economics faculty engages in research in the emerging and cutting-edge interdisciplinary fields such as behavioral economics, big-data science, decision theory, and neuroeconomics. Our doctoral students receive personalized attention from the faculties and engage in collaborative research with the faculty members early in their careers. Participation in conferences and department seminars is encouraged. Students also actively participate in subdiscipline-specific research groups.

SPECIAL FACILITIES

MA Facilities

Students enrolled in the MA program are eligible to access the university facilities, including but not limited to the library and computing facilities.

The Department

Students on Teaching and Research assistantship are allocated office space with internet access in the department. The students also have access to an experimental economics lab located in 2088 Derring Hall.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (90.0)

GRE

General Test: Quantitative (155.0)

Students seeking the Ph.D. must complete 90 total credit hours of work, consisting of 24 credit hours of core requirements, 21 credit hours of field courses, 30 credit hours of research & dissertation, and an additional 15 credit hours of research & dissertation or other Graduate level courses with the permission of the Graduate Director. The Economics Department does not offer Spring admission. Nor does it offer summer courses for graduate students.The PhD in Economics is a STEM discipline.

MA Degree

Offered In (Blacksburg)

Students seeking the M.A. in Economics must complete 30 total credit hours of work, consisting of core requirements and optional field courses. Field courses require prior approval from the Graduate Director. The Economics Department does not offer Spring admission. Nor does it offer summer courses for graduate students.

GRADUATE COURSES (ECON)

ECON 5005:

Prices, Markets, and Resource Allocation

This sequence, which is part of the core curriculum in the Economics Ph.D. program, covers fundamental concepts at the foundation of modern microeconomic theory. The sequence relies heavily on calculus and other mathematical tools. 5005: noncooperative game theory, competitive and non-competitive markets, theory of the firm. 5006: consumer theory, general equilibrium and welfare economics, uncertainty and asymmetric information.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECON 5006:

Prices, Markets, and Resource Allocation

This sequence, which is part of the core curriculum in the Economics Ph.D. program, covers fundamental concepts at the foundation of modern microeconomic theory. The sequence relies heavily on calculus and other mathematical tools. 5005: noncooperative game theory, competitive and non-competitive markets, theory of the firm. 5006: consumer theory, general equilibrium and welfare economics, uncertainty and asymmetric information.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5005 (UG) OR ECON 5005

Corequisite(s):

ECON 5015:

Theory of Money, Income, Employment, and the Price Level

Part of core curriculum in the Econ Phd program providing an intensive treatment of modern macroeconomic and monetary theory. The course uses mathematical tools and analytic concepts. National income accounts; effective demand; neoclassical and Keynesian theories of capital and interest; supply and demand in money securities markets; introduction to macroeconomic dynamics; rational expectations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

ECON 5016:

Theory of Money, Income, Employment, and the Price Level

Part of core curriculum in the Econ PhD program providing an intensive treatment of modern macroeconomic and monetary theory. The course uses mathematical tools and analytic concepts. National income accounts; effective demand; neoclassical and Keynesian theories of capital and interest; supply and demand in money securities markets; introduction to macroeconomic dynamics; rational expectations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5015 (UG) OR ECON 5015

Corequisite(s):

ECON 5124:

Mathematical Methods in Economics

Extensive treatment of new techniques for economic modeling. Review of linear algebra and calculus; static optimization, with Lagrangian and Kuhn-Tucker methods; differential and difference equations; dynamic optimization, with calculus of variations, optimal control and dynamic programming.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECON 5125 (AAEC 5125):

Empirical Research Methods in Economics

Extensive treatment of new techniques for economic modeling. 5125: Probability and statistical inference, linear regression and related dynamic models, specification, estimation, misspecification, respecification, identification. 5126: Simultaneous equations, dynamic systems, time series, limited dependent variable models.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECON 5126 (AAEC 5126):

Empirical Research Methods in Economics

Extensive treatment of new techniques for economic modeling. 5125:

Probability and statistical inference, linear regression and related dynamic models, specification, estimation, misspecification, respecification, identification. 5126: Simultaneous equations, dynamic systems, time series, limited dependent variable models.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECON 5125 (UG) OR ECON 5125
Corequisite(s):

ECON 5144:

Antitrust and Regulation

Markets and market structure. Methods for analyzing regulatory data. Antitrust law with a focus on U.S. institutions. Vertical and horizontal mergers. Anticompetitive behavior with a focus on collusion and monopolization. Regulation of price, entry, and the environment. Cost-benefit analysis, valuing nonmonetary benefits, and contingent valuation studies.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5054, STAT 5214G
Corequisite(s):

ECON 5154:

Empirical Industrial Organization

Basic models and empirical tools in the field of Industrial Organization. Interactions of firms and consumers in markets. Estimation of demand systems. Models of oligopoly and anticompetitive practices. Contractual relationships between businesses. Empirical specification and estimation of static and dynamic models for understanding firm entry and market structure. Models of incentives under asymmetric information and their applications to electronic businesses, financial markets, and health insurance exchanges. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECON 5314G:

Advanced Big Data Economics

Applied econometrics dealing with big data. Theoretical, computational, and statistical underpinnings of big data analysis. The use of econometric models and deep machine learning algorithms to analyze the high-dimensional data sets. Implications in research focusing on economic questions that arise from rapid changes in data availability and computational technology. Materials are hands-on tutorials that come with Python codes and real-world data sets. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECON 5894:

Final Examination

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECON 5945:

Econometric Theory and Practice

An intensive coverage of the most important techniques of econometric estimation and hypothesis testing, addressing the use of both cross-section and time series data. A core sequence in the MA program in both locations. Prerequisite to the research-thesis seminar in Northern Virginia.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECON 2115 (UG) OR ECON 2116 (UG) OR ECON 2005 (UG) OR ECON 2006 (UG) OR ECON 2125 (UG) OR ECON 2126 (UG) OR ECON 2025H (UG) OR ECON 2026H (UG) OR ECON 2115 OR ECON 2116 OR ECON 2005 OR ECON 2006 OR ECON 2125 OR ECON 2126 OR ECON 2025H OR ECON 2026H
Corequisite(s):

ECON 5946 (AAEC 5946):

Econometric Theory and Practice

An intensive coverage of the most important techniques of econometric estimation and hypothesis testing, addressing the use of both cross-section and time series data. A core sequence in the MA program in both locations. Prerequisite to the research-thesis seminar in Northern Virginia.
Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AAEC 5126 OR ECON 5126

Corequisite(s):

ECON 5964:

Experimental Economics

Laboratory techniques are valuable for answering research questions which defy traditional empirical analysis due to lack of field data. Examples include proposed regulations, new market designs and tests of theory. The goal of this course is two-fold: to develop skills in experimental methods appropriate for economics and related fields and to familiarize students with the results of experimental tests of economic theory. Requirement: Graduate or honors undergraduate, major standing, and permission of the departmental director of graduate study or course instructor.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECON 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

ECON 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECON 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ECON 6004:

Strategic Behavior

Emphasizes strategic behavior in the presence of multiple decision makers. Game theory deals with strategic interaction and provides the formal framework to describe and analyze situations with conflicting interests--as well as situations with both common and conflicting interests. Proof of applicability is provided by means of numerical examples and real life cases, e.g., bargaining, contract theory, economic policy games, and voting.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECON 5005 (UG), ECON 5006 (UG)) OR (ECON 5005, ECON 5006)

Corequisite(s):

ECON 6014:

Behavioral Economic Theory

Psychological, social, and cognitive factors in economic decisions. Topics include risk and ambiguity, intertemporal choice and self-control, bounded rationality, heuristics, emotions, social norms, social preferences, learning, attention, and inference. Applications include contracting, bargaining, labor, development, industrial organization, finance, and macroeconomics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5006

Corequisite(s):

ECON 6024:

Advanced Topics in Econometrics Theory

This course assumes a basic understanding of multiple regression and simultaneous equations modeling and introduces students to advanced econometric techniques commonly used in empirical work. These techniques include linear time series modeling in the time domain, discrete choice models, and panel data methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5126 (UG) OR ECON 5126

Corequisite(s):

ECON 6054:

Development Economics

A modern approach to economics of growth and development for graduate students in economics and related disciplines. Topics include sources of growth; neo-classical, endogenous, and dualistic theories of growth; households economics and human capital accumulation; economics of population; and consequences of imperfect market for land, labor and capital.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECON 3104 (UG), ECON 3204 (UG)) OR (ECON 3104, ECON 3204)

Corequisite(s):

ECON 6104:

Labor Economics

Labor demand and supply, investment in human capital, discrimination in the labor market, and the theory of equalizing wage differentials; search and unemployment, unions, and income distribution.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5005 (UG) OR ECON 5005

Corequisite(s):

ECON 6114:

Advanced Topics in Labor and Health Economics

Research-oriented course covering topics in labor and health economics such as labor market externalities, social networks and social interaction effects, treatment effects and social program evaluation, health behaviors and health care, and social mobility. Analysis of popular datasets such as Add Health and The National Health Interview Survey. Theoretical and applied tools to assess policy-related arguments. Current research and key academic papers in the field, as well as the essential empirical methods and models used by economists.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5126

Corequisite(s):

ECON 6204:

Public Economics

This course describes the theory of government expenditures, stressing market failure as the rationale for government activity. The course describes the normative outcome achieved by a benevolent government, and the positive outcome achieved under rules of collective choice. Tax policy for different levels of government and selected topics in state and local public finance are also addressed.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECON 5005 (UG), ECON 5006 (UG)) OR (ECON 5005, ECON 5006)

Corequisite(s):

ECON 6404:

Industry Structure

Effects of industry structure on price and non-price behavior of firms, on market equilibrium, and on economic welfare. Problems of oligopolistic industries and analysis of government policies (regulation, anti-trust).

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5005 (UG) OR ECON 5005

Corequisite(s):

ECON 6554 (AAEC 6554):

Panel Data Econometrics

Introduction to major panel data techniques and modeling ideas currently employed (e.g., dynamic panel, panel for discrete choice model, treatment effect and program evaluations etc.), including both statistical theory derivations and practical applications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (AAEC 5125 OR ECON 5125), AAEC 5126

Corequisite(s):

ECON 6564 (STAT 6564) (AAEC 6564):

Bayesian Econometric Analysis

Bayesian estimation of economic models, with focus on Gibbs sampling, hierarchical modeling, data augmentation, and model search. Strong emphasis on programming and computational implementation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AAEC 5126 OR ECON 5126 OR STAT 5304 OR STAT 5444

Corequisite(s):

ECON 6614:

Philosophical Foundations of Econometrics

The philosophical and methodological problems underlying econometric modeling and inference. Topics include the distinction between statistical and substantive significance, the proper interpretation of inference p-values, data mining, and other issues related to reliable inference and learning from data.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5125

Corequisite(s):

ECON 6704:

Frontiers of Macroeconomic Research

Theoretical frameworks for real business cycle models, New Keynesian models, and monetary policy. Applying network theory and information theory to macroeconomics. Dynamic modeling, programming, and empirical macroeconomics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECON 5006, ECON 5016

Corequisite(s):

ECON 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECON 6994:

Research Seminar

Review and discussion of current research in economics by students, faculty members, and guest speakers. This course may be repeated for a maximum of 6 credits. Students are required to have Doctoral Standing in Economics.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECON 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDUCATION, CAREER AND TECHNICAL EDUCATION

Natalie Ferand, Program Director

Emeriti Faculty: Daisy Cartwright; Konrad Eschenmann; William Price;

Professors: Rickie Rudd; Tracy Rutherford; H Sutphin;

Associate Professors: Joseph Mukuni; Hannah Scherer; Donna Westfall-Rudd;

Assistant Professors: Natalie Ferand;

General Contact: nferand@vt.edu

CTE website: https://liberalarts.vt.edu/departments-and-schools/school-of-education/academic-programs/career-and-technical-education-program.html

Program Director: Joseph Mukuni, (540-231-0919) Website: https://liberalarts.vt.edu/academics/majors-and-minors/career-and-technical-education-agricultural-education-major.html The program is designed to prepare individuals for careers in Career and Technical Education and to enhance the professional development of current career and technical educators. The CTE program offers a Master of Science degree (M.S.), an Education Specialist degree (Ed.S.) and students can earn a doctoral degree in Education Curriculum and Instruction (EDCI) with a focus on CTE. There are two concentrations in the M.S. degree program: teacher licensure and professional development for practicing educators. The teacher licensure concentration includes all the requirements for earning the master's degree and all the Virginia Department of Education requirements for earning a license to teach in one or more of the CTE program areas: Agricultural Education Business and Information Technology Education Family and Consumer Sciences Education Marketing Education The professional development for practicing educator’s concentration provides professional development for individuals in one or more of the following CTE program areas: Agricultural Education Business and Information Technology Education Family and Consumer Sciences Education Health and Medical Sciences Marketing Education Trade and Industrial Education Technology Education The doctoral program in Curriculum and Instruction is primarily for individuals wishing to pursue a CTE teacher education position at a college or university or for individuals. The Ed.S. degree is appropriate for individuals who seek careers in CTE programs at the local or state level and who already hold a master's degree. In addition to the degree options, the Virginia Tech CTE program also provides online professional studies courses for provisionally licensed CTE teachers. Courses taken in this program can also be used toward earning the M.S. degree.

SPECIAL FACILITIES

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DEGREES OFFERED

MSED Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

The requirements for the different master's degree concentrations vary and also depend on the student's background and goals. Please see the CTE program web site and consult an advisor for specific information. Additional testing for licensure include Praxis 1, VCLA, and an industry certification exam.

EdS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The Ed.S. degree requires a minimum of 60 credits beyond the bachelor's degree or 30 credits beyond the master's. Please see the CTE program web site and consult an advisor for specific information.

GRADUATE COURSES (EDCT)

EDCT 5274:

Internship in Business

While employed in a business occupation, the student completes an In-depth study of the firms policies, practices, and procedures. Under the supervision of the employer and a Career and Technical Education professor, focuses on various aspects of the business. Pre-requisite: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5604:

Foundations of Career and Technical Education

Focus on the history and development of career and technical education with emphasis on the philosophical bases of the field. The conduct and purposes of career and technical education under different philosophical orientations are compared. An overview of the organization and administration, the relationship of career and technical education to agencies both in and outside of education, and how economic conditions have impacted career and technical education are explored. Definition and development of a personal philosophy is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5614:

Curriculum Development in CTE

Provides prospective career and technical education teachers with research bases, resources, and available curricula for teaching content in their respective fields. Develops the ability to plan, manage, develop, and evaluate curricula. Pre-requisite: Graduate standing in the CTE degree program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5624:

Managing CTE Program

Responsibilities of the career and technical education teacher regarding work-based program standards, student guidance, school and community relations, on-the-job training, youth organization sponsorship, work-based program coordination, and program management. Prerequisite: Graduate Standing Required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5634:

Curriculum and Instructional Processes in Career & Technical Education

Planning CTE courses and units of instruction to include industry competencies and academic standards of learning, performance objectives, and performance assessment. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5654:

Strategies for Teaching Career and Technical Education

Focus on identifying the major instructional methods that are appropriate in career and technical education and identifying and resolving problems that emerge from these methods that can have a negative impact on the overall effectiveness of the teacher. Various methods to evaluate the teachers instructional effectiveness are addressed. Graduate standing or two years of teaching experience required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5684:

Advanced Curriculum Development & Program Mgmt in Career & Technical Educ

Integrative learning development in Career and Technical Education (CTE) through incorporation of classroom and extracurricular experiences. Strategies and best practice to ensure interdisciplinary CTE cultural relevance. Methods of facilitating teacher professional development. Student safety.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (EDCT 5614 OR EDCT 5634), EDCT 5624

Corequisite(s):

EDCT 5714:

Education and Work in a Changing Society

This course explores the major social, economic, and political issues and trends expected to have continuing impacts on career and technical education and the workforce. The current status and philosophies of career and technical education are evaluated relative to these changes. Alternative directions for the future are identified and analyzed, with emphasis on proactive rather than reactive strategies for educators.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCT 5604 (UG) OR EDCT 5604

Corequisite(s):

EDCT 5754:

Internship in Education

Student participation in a planned clinical experience under supervision of a university staff member in an appropriate work center. (Max 12C). Consent required.

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5784:

Graduate Seminar in Education

Selected topics in career and technical education related to curriculum development, special education, administration, research, and evaluation. (Max 6C per course)

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

EDCT 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5964:

Field Study

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

EDCT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDCT 6604:

Administrative Leadership for Career and Technical Education

Administrative structure of career and technical education at the local, state, and national levels, and in business and industry; leadership for administrative planning, facilities and support services management, personnel management, supervision of instruction, professional development, and assessment in career and technical education. Alternate years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 6664:

Policy Analysis for Education and the Workforce

In depth treatment of the nature of policy and the policy-making process as they pertain to the workforce and to education, especially to career and technical education. Included are significant aspects of policy development at local, state, and federal levels; examination of the basic questions that are answered by policy decisions; appropriate organizations for formulation of policy; an examination of current policy pertaining to career and technical education at state and federal levels; and procedures for establishing policy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCT 5604 (UG) OR EDCT 5604

Corequisite(s):

EDCT 6944:

Professional Seminar

Critical review, presentation, and discussion of current literature, research, and national reports in designated areas of education. (6C max. credit allowed toward program of study) Consent required.

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 7754:

Internship in Education

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 7964:

Field Studies in Education

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDUCATION, COUNSELOR EDUCATION

Matthew Fullen, Program Director

Professors: Gerard Lawson; Laura Welfare;

Associate Professors: Hannah Bayne; Matthew Fullen;

Assistant Professors: Breanna Ellington; Tameka Grimes;

Graduate Contact: mfullen@vt.edu

Counselor Education website: https://liberalarts.vt.edu/departments-and-schools/school-of-education/academic-programs/counselor-education-program.html

The Virginia Tech Counselor Education program offers a master's program (M.A.E.D) at the Virginia Tech Roanoke Center and a doctoral program (Ph.D.) at the main campus in Blacksburg. The Virginia Tech Counselor Education Master's program is a 60 credit hour program, which generally takes a full-time student two years to complete. The first summer and fall semesters of the program consists of classroom study, and beginning in the spring semester students are engaged in clinical study throughout the remainder of their program. Students who graduate with a master's degree in the school counseling track are qualified and endorsed by the faculty for licensure/certification as school counselors by the Virginia Department of Education. Those who graduate with a master's degree in the clinical mental health counseling track have completed all the courses required for LPC licensure in Virginia, and are prepared to enter the licensure residency period. Graduates need to complete additional hours of supervised practice to be eligible for licensure in Virginia, and can include their internship hours toward this state requirement. The Virginia Tech Counselor Education doctoral program prepares students through coursework and practical training to serve as counselor education faculty, clinical supervisors, or K-12 school counseling leaders. Strong preference in admission is given to applicants with at least two years of post-masters clinical experience. Doctoral students complete advanced practica or internships in Teaching, Clinical Supervision, Clinical Practice, Research, and/or Advocacy and Leadership. Doctoral students in the Virginia Tech program work closely with the faculty, and often collaborate on research, publications, and conference presentations. Students who complete the doctoral program typically seek employment as faculty members in counseling programs colleges and universities, and in mental health settings in the community, hospitals, higher education, and K-12 schools. If students have not completed their LPC requirements prior to admission, courses and clinical doctoral internships can support that process.

SPECIAL FACILITIES

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DEGREES OFFERED

MA Degree

Offered In (Roanoke)

TOEFL

iBT: (90.0)

The masters program requires a minimum of 60 credit hours and a comprehensive exam, and the doctoral degree requires a minimum of 100 hours (post-baccalaureate) and a dissertation. Degree programs are accredited by the Council for Accreditation of Counseling and Related

Educational Programs (CACREP) and by the National Commission of Accreditation and Teacher Education (NCATE). They are also approved by the Virginia Department of Education for the preparation of school counselors. Because the master's program is housed off campus, we are not able to admit international students.

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

The masters programs require a minimum of 60 credit hours and a comprehensive exam, and the doctoral degree requires a minimum of 100 hours (post-baccalaureate) and a dissertation. Degree programs are accredited by the Council for Accreditation of Counseling and Related Educational Programs (CACREP) and by the National Commission of Accreditation and Teacher Education (NCATE). They are also approved by the Virginia Department of Education for the preparation of school counselors.

GRADUATE COURSES (EDCO)

EDCO 5204:

Orientation to Professional Counseling

Survey of the philosophy, scope, purposes, and methods employed in a variety of counseling settings including agencies, private practice, higher education, and elementary/middle/secondary schools with emphasis on services offered and professional identity and ethical issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5214:

Theories of Counseling & Consultation

Major theories used to understand and change behavior in a counseling setting. Emphasis is placed on the application of theoretical orientations to understanding and changing behavior of clients. Systematic integration of themes used in the counseling process, including consulting and coordination roles in school and community settings.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5204 (UG) OR EDCO 5204

Corequisite(s):

EDCO 5224:

Counseling Techniques

Systematic integration of techniques used in the counseling process. Course provides extensive practice, learning, integrating, and practicing skills characteristic of effective helping relationships. Extensive use is made of audio and video feedback in critiquing counseling interviews and techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5214 (UG) OR EDCO 5214

Corequisite(s):

EDCO 5234:

Group Counseling

Introduction to group counseling theory and practice. Emphasis on application of group counseling principles to practical settings. In a laboratory setting, students receive feedback about their personal behavior in a group and supervised practice in the design, implementation, and evaluation of a short term group counseling project.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (EDCO 5214 (UG), EDCO 5224 (UG)) OR (EDCO 5214, EDCO 5224)

Corequisite(s):

EDCO 5244:

Counseling Diverse Populations

Examination and application of counseling strategies for special client populations including the exceptional; economically disadvantaged; culturally, racially and ethnically different; those with different life styles. Emphasis on the range of human characteristics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5204

Corequisite(s):

EDCO 5254:

Career Development and Information Services

Evolution of how the relationships of work and leisure have evolved into the concept of Career Development. Brief review of the major theories of Career Development and their application to the collection, evaluation, and use of career information in a variety of counseling/student development settings.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5204 (UG) OR EDCO 5204

Corequisite(s):

EDCO 5264:

Appraisal In Counseling

Various individual and group tests and informal approaches to better understanding of the individual in counseling. Case study methods examined in detail. Interpretation of test data and role of counselor in testing emphasized. Designed for masters level counselor preparation. 12 additional hours of suitable courses in education, psychology, or statistics required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5204 (UG), (EDRE 5404 (UG) OR EDCI 4604 (UG)) OR EDCO 5204, (EDRE 5404 OR EDCI 4604)

Corequisite(s):

EDCO 5284:

Practicum: Counselor Education

Supervised experience in the practice of counseling. Didactic instruction in advanced counseling techniques and methods coupled with practice with clients in a supervised setting. Extensive feedback on counseling practice in individual sessions and group seminar. Must have liability previous course work in the field required. insurance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (EDCO 5204 (UG), EDCO 5214 (UG), EDCO 5224 (UG)) OR (EDCO 5204, EDCO 5214, EDCO 5224)

Corequisite(s):

EDCO 5344:

Systems Counseling

Use of systems theory in practice of counseling. Influence of systemic factors on human development, theories of family development, and counselors role to remedy institutional and social barriers. Emphasis on counseling skills including systemic case conceptualization and clinical intervention used with individuals, couples or families, and other systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5204

Corequisite(s):

EDCO 5354:

Addictions Counseling

Provides an overview of the strategies, goals, methodologies, programs and types of knowledge and skills necessary for effective identification and treatment of addictions Examines the classifications of drugs and other process addictions; impact of addictions on clients and their family members; components of addiction and recovery; prevention, treatment and relapse prevention resources; and salient legal and ethical guidelines. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5364:

School Counseling

Theory and practice of school counseling at the elementary, middle, and high school level, and introductory skills for those settings. Provides understanding of basic services performed by the school counselor; developmental characteristics of the age groups served; ethical, legal and societal issues that affect school counselors; special education terminology; techniques useful in school counseling; and sources of materials available for educational and career counseling at various school levels.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (EDCO 5204 (UG), EDCO 5214 (UG)) OR (EDCO 5204, EDCO 5214)

Corequisite(s):

EDCO 5374:

Clinical Mental Health Counseling

Counselor preparation for clinical mental health setting. Wellness, management of services and programs, counselor role and legal issues for a multi-cultural society in clinical mental health. Current controversies and professional issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5204, EDCO 5214

Corequisite(s):

EDCO 5424 (HD 5424):

Life Span Development

Stages of individual development as they occur in the context of the family life course. Overview of current developmental theories. Impact of race, gender, and class on cultural views of developmental norms.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5514:

Counseling Evidence-Based Practices and Research

Consuming and producing counseling research and evaluation. Quantitative, qualitative and mixed-methods, used ethically and culturally informed. Advocacy and decision-making using data analysis from research and program impact. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5554:

Crisis Prevention, Preparedness, and Response

Assessment of school and community climate and principles of personal and community crisis prevention for counselors, teachers, and school administrators. Preparedness strategies appropriate for typical reactions to crises and relevant to special populations. Preparation and evaluation of crisis response plans that promote mental health and optimize potential for resilience and self-care. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5564:

Expressive and Experiential Techniques in Counseling

Basic principles and practices of intermodal expressive arts therapy. Integration of expressive theories and techniques in individual and group counseling. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5604:

Graduate Seminar in Education

Selected topics in administration, counseling, adult and continuing education, research and evaluation, and community college and other domains of higher education. Emphasis is on interactive discourses on topics not typically included in regularly scheduled courses. (Maximum 3C per course).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5614:

Internship

Clinical experience (minimum 600 hours) under the supervision of a university staff member and a site supervisor in an appropriate field site: school (at least 300 hrs K-6 & at least 300 hrs 7-12), community agency, university counseling center, or other setting. Extensive feedback in individual sessions and group seminar. (12 hours minimum for program). Must have liability insurance.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCO 5284 (UG) OR EDCO 5284

Corequisite(s):

EDCO 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

EDCO 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDCO 6304:

Clinical Supervision

A didactic and clinical study of supervision. Training in the differential conceptual approaches and the different methodologies of supervision, as well as the application of the theory and skills to actual supervisory processes with supervisees. Trainees will supervise masters students and document their supervision skills for clinical review. Students will supervise a counselor or intern as a part of the course and document with videotape. Must have liability insurance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6324:

Professional Counselor Education and Supervision

Counselor Education and Supervision (CES) professional responsibilities and diversity issues. Council for Accreditation of Counseling and Related Educational Programs (CACREP) accreditation standards and process. Pedagogy, curriculum design and evaluation for adult learners relevant to counselor education and supervision. Program evaluation. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6404:

Advanced Counseling Theories and Multicultural Implications

Theories of counseling are examined in the context of contemporary research and practice, with particular attention to diverse populations and cultural influences. Effectiveness of selected past and contemporary counseling theories and practice with different populations is evaluated.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (EDCO 5214 (UG), EDCO 5224 (UG)) OR (EDCO 5214, EDCO 5224)

Corequisite(s):

EDCO 6434:

Researcher Development in Counselor Education

Researcher identity development through examining design, professional writing, reflexivity, ethical and cultural considerations when designing topics, questions, methodology and dissemination in Counselor Education. Evaluation of counseling and program impact. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6474:

Advanced Practicum

Provides advanced graduate students in counseling/student development with in-depth supervision and student personnel experiences in various field settings. Experiences accompanied by intense faculty supervision and evaluation. (Maximum 12C). 30 hours previous coursework in the field required.

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

Prerequisite(s):

Corequisite(s):

EDCO 6484:

Leadership and Advocacy Issues in Counselor Education

Leadership and advocacy theories, skills, and strategies in professional counseling and counselor education as applied to school, clinical mental health counseling, and/or higher education settings. Ethical and cultural strategies and social justice implications of leadership and advocacy. Social and political issues impacting the counseling profession and the individual, systemic, and policy-level skills of advocacy. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6524:

Doctoral Internship

Provides advanced graduate students in Counselor Education with in-depth supervision and experiences in various field settings for a minimum of 600 clock hours. May include supervised experiences in a clinical setting, clinical supervision, and teaching. Includes most activities of a regularly employed professional in the setting. Experiences accompanied by intense faculty and on-site supervision and evaluation. (12 hours minimum required in program). Must have liability insurance and instructor consent.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6534:

DSM Application in Counseling

Advanced study of the criteria of mental disorders and standard diagnostic and assessment procedures. Provides students with the extensive knowledge and skills necessary to differentiate abnormal from normal behavior in children and adults, with special emphasis upon the identification and assessment of the mental disorders included in the Diagnostic and Statistical Manual of Mental Disorders (DSM). Emphasis will be on the application of the DSM in counseling situations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

EDCO 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 7714:

Internship in Education

Planned program of advanced clinical practice in education through assignment under direct supervision of outstanding practitioner for periods of up to two semesters. (Maximum 24C).

Credit Hour(s): 1 TO 24

Lecture Hour(s): 1 TO 24

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCO 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDUCATION, EDUCATIONAL LEADERSHIP AND POLICY STUDIES

Jodie Brinkmann, Program Director
Charles Lowery, Program Director

Emeriti Faculty: David Parks; Richard Salmon; Travis Twiford; Wayne Worner;

Professors: Michael Alexander; Carol Mullen;

Associate Professors: Charles Lowery;

Professor of Practice: Carol Cash;

Assistant Professor of Practice: Jodie Brinkmann;

General Contact: nbradley@vt.edu

Main Page: https://liberalarts.vt.edu/departments-and-schools/school-of-education/academic-programs/educational-leadership-program.html

Program Leader: Jodie Brinkmann, (jlbrinkmann@vt.edu), Virginia Tech Richmond Center, 2810 Parham Road, Suite 300, Richmond, VA 23294) Graduate Program Director: Nancy Bradley, (nbradley@vt.edu, 540-231-5220) Website: https://liberalarts.vt.edu/departments-and-schools/school-of-education/academic-programs/educational-leadership-program.html This is a graduate program developed by Virginia Tech to prepare educational administrators for leadership roles in school systems and related agencies. Admissions Process and Selection Criteria: Admission to graduate study in educational leadership requires acceptance by both the Educational Leadership and Policy Studies program and Virginia Tech's Graduate School. Admission criteria are: An appropriate degree; A grade point average (GPA) of at least 3.3 (on a 4.0 = A scale) on previous graduate work for admission to a doctoral degree program or 3.0 for admission to a master's degree or Ed.S. degree program; Administrative/leadership experience for the doctoral degree; Strong communication skills; At least 3 strongly supportive letters of recommendation, one from the applicant's superintendent is preferred and two from other professional associates; A successful interview with a faculty committee from Virginia Tech; Scores on the Graduate Record Examination are required for the Ph.D. option. Doctoral Program in Educational Leadership Degrees Offered: Successful completion of the program will result in award of the Ph.D. or Ed.D. in Educational Leadership and Policy Studies. Locations: Educational Leadership offers doctoral programs at the following locations: Blacksburg campus of Virginia Tech/Virginia Tech Center at Higher Education Center in Roanoke Virginia Tech Northern Virginia Center in Falls Church Virginia Tech Hampton Roads Center in Virginia Beach Virginia Tech Richmond Center Virginia Tech Center at the Southwest Virginia Higher Education Center in Abingdon The EdD degree program is organized and delivered at each site in cohorts of approximately 15 students who are practicing professionals. The PhD option is available on the Blacksburg campus to students who wish to pursue university teaching or careers in policy related work. Only a few students are admitted into the Ph.D. option each year. The number of admissions is limited so that faculty may offer students the support and guidance they need. Curriculum: Successful candidates will complete a minimum of 63 postmaster's credits for the Ed.D. and 69 postmaster's credits for the Ph.D. The program extends over a 36-month period and covers coursework in foundations, applied studies, research, cognates, and the dissertation. Part-time students take at least two courses each semester, including each summer session over approximately a three-year period. Coursework includes, but is not limited to, governance and policy, quantitative and qualitative research methods, literature reviews, advanced school law, advanced school finance, legal aspects of special education, theories of educational administration, planning educational facilities, and administration of instructional programs. Special topics will cover school safety, testing and the Standards of Learning, school accreditation, diversity, ethics, and the politics of education. An individual program of studies is planned for each student and depends upon the student's previous academic record, background, and interests. Master's or Education Specialist Program in Educational Leadership The Program for the Preparation of School Principals and Supervisors began in the fall of 1971 following an eighteen-month study of school leadership by practicing administrators and supervisors, university faculty, and state department of education officials. The resulting cohort program is learning centered, field sensitive, team taught, technologically and resource rich, performance driven, and problem oriented. It is offered in Northern Virginia, Hampton Roads, Richmond, Roanoke, Abingdon, Blacksburg, and at other sites in Virginia. It is also offered on-line, beginning 2020. It is reviewed and revised annually to meet the changing needs of school leaders. Applicants who have previously earned a master's degree may complete an Education Specialist (Ed.S.) degree through this program. Sense of Purpose: Talented educators are prepared through this program for positions in school administration and supervision. Graduates are able to work collaboratively with teachers, students, parents, and community leaders in the development of school programs that encourage and promote the growth of all students. They possess the management skills needed to support a productive learning environment for students and teachers. They have the ability to work side-by-side with educators, parents, and community agencies in developing, implementing, and evaluating programs designed to prevent or to confront learning and behavioral difficulties. They are able to work with teachers, children, parents, and community members with diverse needs, views, and values. They have a professional code of ethics and are able to function effectively within local, state, and federal laws, rules, and regulations. Above all, they are caring and competent human beings. A Practical Knowledge Base: The program is based on the Professional Standards for Educational Leaders (PSEL), and is accredited by the Council for Accreditation of Educator Preparation (CAEP) and the Virginia Department of Education (VDOE). Further, the knowledge and skill objectives were identified, and are periodically reviewed, by practicing school administrators and supervisors. These standards and objectives are incorporated into the courses and internship experiences of the program. Heavy emphasis is placed on student learning, collaborative leadership, a productive culture, shared decision making, and planned change. Facilitative Instructional Practices: Courses are performance based and technologically rich. Students use case materials, simulations, and real-life problems to learn various approaches to decision making and problem solving. Both faculty and students favor problem-based learning; it is now used in one form or another in all courses. Both video conferencing and computer-based learning management software are used to facilitate communication among individual students and faculty, among small groups, and between cohorts. An internship begins in the first semester and continues for the entire program. Interns select, with the approval of the campus supervisor, a mentor. A minimum of 350 clock hours with a minimum of 120 clock hours directly focused on improving student learning is required. The intern works a minimum of 120 clock hours at one school level; a minimum of 40 clock hours at the other school levels (elementary, middle, or high); a minimum of 40 clock hours at the central office; and a minimum of 30 clock hours in agencies that deal with children or families. All experiences are on site and are designed to meet the required objectives spelled out in the internship manual. The mentor or campus supervisor approves all experiences used for the completion of objectives. At least one reading is selected to facilitate the achievement of each objective in the internship. Reflections on the experiences, the readings, and the relationship between the two are recorded in a log, which is regularly reviewed by the on-site and campus supervisors. Selection Procedures: Students are carefully selected for the program. Applicants submit an application form with the usual demographic information; a letter of application describing previous leadership experiences, motives for becoming a school leader, and commitments to education and school administration or supervision; and letters of recommendation from three persons. An interview is conducted using a protocol to assess the applicant's academic potential, commitment to becoming a principal or supervisor, commitment to completing the program, communication skills, educational values, interpersonal skills, leadership potential, teaching experience and performance, and technological competence Two writing samples are required for admission. A sample of the student's best writing is submitted with the application package. Written responses within the supplemental portion of the application are also reviewed for substance and structure. Faculty members, community members, practicing school leaders, and sometimes teachers serve on the interview committee. After a review of materials and the interview, those students with the highest ratings are invited to join the program. Use of Technology: Faculty members integrate instructional technology in every course. The Canvas online course management system may be used to supplement on-site teaching. Video conferencing systems, like ZOOM, connect cohorts across sites. Graduates use distance learning equipment and software, courseware such as Canvas, spreadsheets, scheduling and record keeping software, and presentation software such as Corel's Presentations and Microsoft's PowerPoint throughout the program. They meet the state's technology standards for teachers and administrators, and they have the skills needed to evaluate instructional and managerial software. Please see the Educational Leadership web site for specific requirements for all degrees.

SPECIAL FACILITIES

DEGREES OFFERED

MA Degree

Offered In (Southwest Virginia, Virtual, Hampton Roads, Richmond, National Capital Region, Roanoke)

TOEFL

iBT: (90.0)

The Educational Leadership Program offers the M.A.Ed. degree in Hampton Roads, National Capital Region, Richmond, Roanoke, Southwest Virginia and Virtually. Please refer to the program website for specific requirements.

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

The Educational Leadership Program offers the Ph.D. degree only in Blacksburg. Please refer to the program website for specific requirements.

EdD Degree

Offered In (Southwest Virginia, Hampton Roads, Richmond, National Capital Region, Roanoke)

TOEFL

iBT: (90.0)

The Educational Leadership Program offers the Ed.D. degree in Hampton Roads, National Capital Region, Richmond, Roanoke, and Southwest Virginia. A virtual option will be available in Fall 2020. Please refer to the program website for specific requirements.

EdS Degree

Offered In (Southwest Virginia, Hampton Roads, Richmond, National Capital Region, Roanoke)

TOEFL

iBT: (90.0)

The Educational Leadership Program offers the Ed.S. degree in Hampton Roads, National Capital Region, Richmond, Roanoke, and Southwest Virginia. Please refer to the program website for specific requirements.

GRADUATE COURSES (EDEL)

EDEL 5004:

School Personnel Administration and Instructional Supervision

Administration and supervision of human resources and instructional programs in schools. Content encompasses human resources planning, recruitment, selection, assignment, induction, supervision and appraisal, development, compensation and benefits, employee relations, and other topics of current interest.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5024:

School Law

Federal and state laws governing public education and the legal responsibilities and powers of various state and local governing bodies and individuals. Emphasis given case law, federal and state, affecting such topics as rights of teachers, rights of students, due process, liability, and equal protection.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5054:

Administration of Special-needs Programs

Basic provisions of federal/state laws, policies, and regulations pertaining to special education, vocational education, and other special-needs client groups of the public schools.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5104:

Fnd Education P-12 Leadership

Educational leadership from an historical perspective. Policy implications for school leaders. School- community relationship. Qualities and skills for school leaders to make intentional, thoughtful, and ethical decisions in their schools. Ethics and integrity expectations in educational leadership. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5114:

Leader and Change in P-12 Educ

Leadership and change theories that impact school improvement efforts; skills, and dispositions needed to change organizational culture; globalization and diversity relative to implementing change in educational leadership in the 21st century. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5134:

Curriculum Leadership in P-12 Education

Examination of curriculum through theory, practice, social forces, politics, diversity, and economics; analysis of contemporary P-12 school curriculum and reflection about the values, beliefs, and assumptions informing curriculum leadership; long-range planning and curriculum assessment. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5144:

Instruction Leadership P-12 Ed

Leadership in instructional practices in P-12 education; effective classroom instructional strategies; classroom observation and assessment models; models of including diversity and technology in instructional practices; leading instructional professional development to increase student learning evaluating pedagogy. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5164:

Research and Assessment for K-12 Educational Leaders

Prepares K-12 educational leaders to use research and assessment data to make appropriate data-driven decisions at classroom, school, and division levels; analysis of data both generated in the school and state- or agency- controlled; best-practices in school improvement. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5604:

Graduate Seminar in Education

Selected topics in administration, counseling, adult and continuing education, research and evaluation, and community college and other domains of higher education. Emphasis is on interactive discourse on topics not typically included in regularly scheduled courses. (Maximum 3C per course).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5614:

Internship

Student participation in a planned clinical experience under the supervision of a university staff member in an appropriate work center. (Maximum 12C). Consent required.

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

EDEL 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDEL 6004:

Theories of Educational Administration

A general course for students of administration in public and private schools, community colleges, four-year colleges, and universities. Content includes purposes and nature of theory in educational administration and the application of organizational theory to education. Theories of decision making, communication, leadership, climate, power, conflict, change, morale, and motivation are covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6014:

Administration of Instructional Programs and Support Services

The roles and responsibilities of central office (system) and building level (school) personnel in the administration of instructional programs and services. Students engage in a variety of activities designed to improve their skills in planning, organizing, delivering, and monitoring instructional programs and services within this dynamic environment. Must have administrative or supervisor certification and experience.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6024:

Public School Budgeting

Policies, principles, and practices involved in the practice of public school budgeting.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6034:

Planning Educational Facilities

Basic information needed by administrators to mount an effective planning effort within an organization; to plan, develop, and maintain satisfactory buildings to house modern educational programs; to supervise the work of other professionals and technicians in designing and constructing facilities; and to evaluate such efforts. Meets Virginia requirements for placement on the Eligible List of Division Superintendents.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6044:

Governance and Policy in Education

Antecedents of public policy affecting education in the United States, and the relationships between policy making and implementation and educational administration.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6104:

Literature Reviews in K-12 Educational Leadership

Literature reviews in educational leadership and related fields; analysis, critique and synthesis of literature representing research, theory, applicability, and commentary in current topic of interest; preparation of initial literature review; evaluative skills used to identify well-constructed research. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6114:

Applied Qualitative Research in K-12 Educational Leadership

Orientation and approaches to qualitative research. Design and implementation of qualitative research questions and process in K-12 educational leadership. Ethical norms conducting research in the K-12 school setting; responsible use of intellectual property, data collection and reporting, and interactions with human subjects. Observations, interviews, basic data analysis, interpretation and report writing of qualitative research findings.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDEL 5164

Corequisite(s):

EDEL 6124:

Advanced K-12 School Law

Influence of school law on PK-12 education; legal issues that pertain to the public schools, including in-depth analysis of accountability, employee relations, and parental and student rights, with emphasis on issues at central office level; rationale for a legally sound environment for students, faculty, and staff; Virginia and national education codes; school system policies and administrative regulations; legal research development. Pre: 5024 or equivalent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDEL 5024

Corequisite(s):

EDEL 6134:

Advanced Topics in Public School Finance

Education policy and practice pertaining to public school finance for educational leaders and policy makers. Equitable distribution of educational monies and resources to achieve desired student outcomes. Linking of availability of sufficient resources with a school divisions ability to educate all students to the highest standards. Pre: EDEL 5034 or equivalent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6254:

Legal Aspects of Special Education

Review and analysis of current case law and litigation related to special education. Focus on the legal system that assures children with disabilities free appropriate public education, with emphasis on due process procedures and other procedural safeguards, discipline, program accessibility, and application of the least restrictive alternative principle in special education programming.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6914:

Problems in Education

Study of contemporary problems in various education settings such as administration, counseling, community college education, and adult and continuing education. (Maximum 3C per course).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 6924:

Professional Seminar

Critical review, presentation, and discussion of current data-based and issues-related literature, either published or presented at recent national meetings. Provides students an opportunity to amalgamate their prior course experiences to produce a draft dissertation prospectus. (Maximum 6C credit allowed toward program of study).

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 7704:

Field Studies in Education

Advanced applied research and/or evaluation study in one or more educational institutions or agencies. The student is graded on the basis of the design of the study and ability to conduct the study and report the results. (Maximum 12C).

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 7714:

Internship in Education

Planned program of advanced clinical practice in education through assignment under direct supervision of outstanding practitioner for periods of up to two semesters. (Maximum 24C).

Credit Hour(s): 1 TO 24

Lecture Hour(s): 1 TO 24

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDEL 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ELECTRICAL ENGINEERING

Luke Lester, Head

Emeriti Faculty: Peter Athanas; Aloysius Beex; Robert Broadwater; Gary Brown; C Clauer; William Davis; Gregory Earle; Louis Guido; Mark Jones; Fred Lee; Cameron Patterson; Arun Phadke; Krishnan Ramu; Warren Stutzman;

Professors: Amos Abbott; Masoud Agah; Paul Ampadu; Scott Bailey; Joseph Baker; Dushan Boroyevich; Richard Buehrer; Rolando Burgos; Virgilio Centeno; Harpreet Singh Dhillon; Dong Ha; Yiwei Hou; Michael Hsiao; Jih Lai; Luke Lester; Chen-Ching Liu; Guo Quan Lu; Thomas Martin; Scott Midkiff; Lamine Mili; Khai Ngo; Mariusz Orlowski; Paul Plassmann; Ting Chung Poon; Saifur Rahman; Binoy Ravindran; Jeffrey Reed; John Ruohoniemi; Walid Saad; Ahmad Safaai-Jazi; Timothy Sands; Wayne Scales; Leonard Smith; Angelos Stavrou; Daniel Stilwell; Joseph Tront; Yue Wang; Anbo Wang; Yong Xu; Jianhua Xuan; Yaling Yang; Guoqiang Yu; Richard Zhang;

Associate Professors: William Baumann; Thidapat Chantem; Jaime De La Reelopez; Steven Ellingson; Ryan Gerdes; Mantu Hudait; Xiaoting Jia; Vasileios Kekatos; Qiang Li; Lingjia Liu; Majid Manteghi; Ali Mehrizi-Sani; Leyla Nazhandali; JoAnn Paul; Ryan Williams; Chris Wyatt; Yang Yi; Haibo Zeng; Wei Zhou; Yizheng Zhu;

Assistant Professors: Jordan Budhu; Christina Dimarino; Thinh Doan; Dong Dong; Ruoxi Jia; Ming Jin; Zin Lin; Elena Lind; Chang Woo Min; Linbo Shao; Wenjie Xiong; Yuhao Zhang;

Grant A. Dove Professor: Yue Wang;

Virginia Microelectronics Consortium Professor of Engineering: Masoud Agah;

Bradley Distinguished Professor: Yiwei Hou;

James S. Tucker Professor: Jih Lai;

Willis Worcester Professor: Jeffrey Reed;

University Distinguished Professor: Dushan Boroyevich; Fred Lee; Arun Phadke;

Clayton Ayre Professor: Anbo Wang;

Joseph R. Loring Professor: Saifur Rahman;

Bradley Faculty Fellow of Education: Thomas Martin;

J. Byron Maupin Professor of Engineering: Wayne Scales;

Elizabeth and James Turner Faculty Fellow: Harpreet Singh Dhillon;

Roanoke Electric Steel Professorship in Engineering: Luke Lester;

American Electric Power: Chen-Ching Liu;

Collegiate Professors: Scott Dunning; Creed Jones; Timothy Talty;

Collegiate Assistant Professors: Arthur Ball; Almuatazbellah Boker; Kendall Giles; Sook Ha; Mary Lanzerotti; Ravi Raghunathan;

Collegiate Associate Professors: Kristie Cooper; Jeffrey Ransbottom; Alkan

Soysal; Nektaria Tryfona;

Hugh P. and Ethel C. Kelly Professor: Richard Zhang;

Graduate Admissions: vt.ece.gradadm@vt.edu

Graduate Advising: vlaura@vt.edu

Student Handbook: https://ece.vt.edu/grad/manual.html

The Harry Lynde Bradley Department of Electrical and Computer Engineering offers graduate degree programs leading to the Master of Engineering (M.Eng.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) in electrical engineering and computer engineering. The M.S. and Ph.D. degree programs are offered through the Blacksburg campus as well as extended campus consortia (National Capital Region, Northern Virginia Center, Falls Church, Virginia; Central; Hampton Roads; Western, and VT-MENA through Alexandria and Cairo, Egypt). The M.Eng. degree is offered at the National Capital Region (NCR) and Virtual campuses.The ECE Department offers both an M.S. Thesis and an M.S. Non-Thesis degree. For the M.S. Thesis degree, each plan of study is developed by the student in consultation with his or her faculty advisor satisfying the M.S. Thesis degree requirements and the defense of a thesis. The M.S. Non-Thesis degree is a coursework-based master's degree. The M.Eng. degree is a professionally-oriented degrees that offers graduate students a strong academic foundation in core ECE technological areas with a culminating, project-based learning experience.The Ph.D. is the highest academic degree awarded by the university and is conferred upon students who demonstrate outstanding original scholarship during advanced study. It signifies that the student can conduct independent research and has both a broad basic knowledge of all areas of the field and a comprehensive knowledge of one area. Students applying for the Ph.D. program typically have a master's degree from an accredited college or university in EE, CPE, or a related field.A direct-Ph.D. option is available for students without an earned master's degree. These students will earn an M.S. Thesis, or an M.S. Non-Thesis, degree in addition to the Ph.D. The Bradley Department of Electrical and Computer Engineering's current enrollment is approximately 610 students. Out of the enrolled students, approximately 95% of our full-time Ph.D. students are funded and approximately 85% of our full-time master's student are funded. Most funding is available in one of three ways: Graduate Teaching Assistantships (GTAs) – awarded by the ECE department; Graduate Research Assistantships (GRAs) – awarded by individual ECE faculty; or Fellowships – awarded by the department to the top applicants to the program. Of the fellowships awarded by the department, the Bradley Graduate Fellowship is the highest honor bestowed on ECE Ph.D. students and is restricted to U.S. citizens only.

SPECIAL FACILITIES

Well-equipped research facilities, labs, and centers are available within the different research areas. For more information, click here.

DEGREES OFFERED

MEng Degree

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (90.0)

IELTS

General: Band (7.0)

The M.Eng. degree requires 30 credit hours, and the following specific requirements must be met: 27 credit hours of coursework (subject to M.Eng. course restrictions) and project and report consisting of either: 21 credit hours of senior and graduate-level coursework and 6 credit hours of Graduate Design Project and Report, ECE 5805 and 5806; or 24 credit hours of senior and graduate-level coursework and 3 credit hours of Project and Report, ECE 5904; 2 credit hours of Seminar, ECE 5944; 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; and A final examination consisting of a presentation of the project and report must be passed. The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

MS Degree

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (97.0)

GRE

General Test: Verbal (153.0), Quantitative (157.0), Writing (4.5)

IELTS

General: Band (7.5)

The ECE Department offers both an M.S. Thesis and an M.S. Non-Thesis degree. The degree requirements for each degree are the following. Master of Science (M.S.), Thesis The M.S. thesis degree program requires 30 credit hours, and the following specific requirements must be met: 18 credit hours of senior and graduate-level coursework (subject to M.S. thesis course restrictions); 9 credit hours of Thesis, ECE 5994; 2 credit hours of Seminar, ECE 5944; 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; and An oral final examination consisting of a thesis defense must be passed. Master of Science (M.S.), Non-Thesis The M.S. non-thesis degree program is a coursework-only degree that requires 30 credit hours, does not require a final examination, and the following specific requirements must be met: 27 credit hours of senior and graduate-level coursework (subject to M.S. non-thesis course restrictions); 2 credit hours of Seminar, ECE 5944; and 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304. The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

PhD Degree

Regular Ph.D. Requirements (for students with a master's degree not earned at Virginia Tech) The regular Ph.D. degree program requires 90 credit hours, and the following specific requirements must be met: 27 credit hours of course work (subject to Ph.D. course restrictions); 60 credit hours of research and thesis, ECE 7994; 2 credit hours of Seminar, ECE 5944; and 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; Direct-PhD Requirements (for students with only an earned bachelor's degree) Obtaining a Ph.D. through the Direct-Ph.D. degree program requires 90 credit hours, and the following specific requirements must be met (depending on whether an M.S. Thesis or an M.S. Non-Thesis degree is obtained): M.S. Thesis and Ph.D. Completing an Electrical Engineering M.S. Thesis degree (coursework transfers to Ph.D. subject to Ph.D. course restrictions); 9 additional credit hours of coursework for PhD (subject to Ph.D. course restrictions); 60 credit hours of research and thesis, ECE 7994; 2 credit hours of Seminar, ECE 5944 (will count for both M.S. and Ph.D. degrees); 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; (will count for both M.S. and Ph.D. degrees). M.S. Non-Thesis and Ph.D. Completing an Electrical Engineering M.S. Non-Thesis degree (coursework transfers to Ph.D. subject to Ph.D. course restrictions); 60 credit hours of research and thesis, ECE 7994; 2 credit hours of Seminar, ECE 5944 (will count for both M.S. and Ph.D. degrees); 1 credit hour of Graduate Student Success in Multicultural Environments, ENGE 5304; (will count for both M.S. and Ph.D. degrees). The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

GRADUATE COURSES (ECE)

ECE 5014:

Research and Development Methods for Engineers

Research and development methods for engineers. Scientific literature searches using bibliometric tools such as Google Scholar and Web of Science. Introduction and significance of the Hirsh-Factor for measurement of scientific productivity. Issues of ethics and integrity including: plagiarism, text reuse, and data falsification; and real-world examples such as the Schon scandal case at Bell Labs. The establishment of the postwar American innovation system as proposed in “Science the Endless Frontier,” a report to the president by Vannevar Bush. An introduction to patent law and intellectual property as it applies to academic and industrial research. Not for CPE-MS, EE-MS, CPE-PhD, or EE-PhD credit. May be taken for CPE-MEng or EE-MEng credit. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5104G:

Advanced Microwave and RF Engineering

Passive and active RF and microwave components and circuits for wireless communications: transmission-line theory; planar transmission-lines and waveguides; S-parameters; resonators; power dividers and couplers; microwave filters; sources, detectors, and active devices; modern RF & microwave CAD. Active RF components. Microwave amplifier design. Microwave Integrated Circuits (MIC). RF Microelectromechanical System (MEMS) components. Microwave systems. RF components for wireless systems. RF components for Ultra Wide band (UWB) systems. Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5105:

Electromagnetic Waves

5105: Fundamentals of pane wave propagation, reflection, and transmission; basic theorems, equivalent currents, and Greens theory; radiation fields generated by current sources. 5106: Electromagnetic fields in the presence of inhomogeneous media; separation of variables; analyses of waveguide, cavity, radiation, and scattering problems; numerical methods. Pre: 5105: Graduate standing; 5106: 5105.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5106:

Electromagnetic Waves

5105: Fundamentals of plane wave propogation, reflection, and transmission; basic theorems, equivalent currents, and Greens theory; radiation fields generated by current sources. 5106: Electromagnetic fields in the presence of inhomogeneous media; separation of variables; analyses of waveguide, cavity, radiation, and scattering problems; numerical methods. Pre: 5105:Graduate standing; 5106: 5105.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s):

ECE 5134G:

Advanced Fiber Optics and Applications

Theory of optical fiber waveguide propagation and design applications in communication and sensing systems. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5144:

Introduction to Electro-Optics

Physical optics, wave propagation in inhomogeneous media, acousto-optic and electro-optic effects and their applications in intensity modulation and phase modulation of laser beams. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 3106 (UG), ECE 3614 (UG)) OR (ECE 3106, ECE 3614)

Corequisite(s):

ECE 5154:

Optical Fiber Sensors

Introduction of basic concepts and definitions in measurement science. Principles of single point sensors including intensity-based, fiber Bragg gratings, gyroscopic and interferometric fiber devices. Time and wavelength division sensor multiplexing techniques. Distributed fiber sensors based on Rayleigh scattering and other optical nonlinearities. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5164 (AOE 5654):

Introduction to Space Science I: The Solar Wind and Magnetosphere

Describes the space environment from the sun to the earths upper atmosphere. Fundamental concepts in space plasma physics will be presented, as needed, throughout the course. Numerous examples of observations and data will be utilized to illustrate the environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment (space weather) on modern technologies such as solid state devices, satellite technology, communication and global navigation systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 3106 (UG) OR ECE 3106

Corequisite(s): ECE 5105

ECE 5174 (AOE 5174):

Introduction to Plasma Science

Underlying physical processes and basic computational techniques for laboratory, space, and technological plasma environments including single particle motion, fluid and kinetic theory of plasmas, plasma waves and instabilities, diffusion and resistivity, and nonlinear effects. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5194:

Remote Sensing: Principles and Techniques

Physical principles involved in remote sensing of Earths environment and their implementation in engineering systems; societal applications of remote sensing; fundamental principles of electromagnetic wave propagation and scattering; passive versus active techniques; remote sensing platforms and systems integration; advanced concepts important for the design and analysis of remote sensing engineering systems. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5200 (MSE 5200):

Semiconductor Alloys and Heterstructures

Advanced treatment of semiconductor materials with an emphasis on binary compounds, ternary and quaternary alloys, and strained-layer structures. Topics include crystal structure; lattice vibrations and phonons; energy band structure; equilibrium and non-equilibrium carrier distributions; electron and hole transport via diffusion and drift; and carrier generation and recombination mechanisms. Graduate standing required in the College of Engineering or College of Science.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MSE 3204 (UG) OR ECE 4214 (UG) OR PHYS 3455 (UG) OR ECE 4214 OR MSE 3204 OR PHYS 3455

Corequisite(s):

ECE 5204:

Power Semiconductor Devices

Characteristics, fabrication, and application of power semiconductor devices, which may include p-i-n and Schottky diodes, insulated gate biopolar transistors, field effect transistors, and thyristors. Effect of semiconductor material, device structure, and current injection levels on device performance. Device drive requirements and power circuit interaction. Implementation of power devices using wide band gap semiconductors such as silicon carbide and gallium nitride.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5200

Corequisite(s):

ECE 5205:

Basic Semiconductor Devices

Description of the performance characteristics and limitations of basic semiconductor electronic devices in terms of the properties of semiconductor materials and device structure.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5210:

MicroElectroMechanical Systems: From Fabrication to Application

MicroElectroMechanical Systems (MEMS) are very-small systems or systems made of very small components. The course focuses on the design, fabrication, and application of microsystems providing a unique opportunity for interdisciplinary interactions. The course consists of lectures, readings from the current literature, discussion by students, and team-work projects. The major topics covers are: materials in MEMS; microfabrication techniques; sensing and actuating mechanisms; wafer-level packaging; and case-study of some MEMS-based devices and lab-on-a-chip systems. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4234 (UG) OR ECE 4234 OR BCHM 4124 (UG) OR BCHM 4124 OR CHE 4114 (UG) OR CHE 4114 OR CHEM 4124 (UG) OR CHEM 4124 OR ESM 4014 (UG) OR ESM 4014 OR ESM 4024 (UG) OR ESM 4024 OR ME 4304 (UG) OR ME 4304 OR ME 4404 (UG) OR ME 4404 OR MSE 4254 (UG) OR MSE 4254 OR MSE 4354 (UG) OR MSE 4354

Corequisite(s):

ECE 5224:

Principles of Electronics Packaging

Electrical, thermal, mechanical, and thermomechanical design of electronics packaging. Materials and process selection guidelines for the fabrication and reliability of single- and multi-chip electronics packages. Methods for characterization and testing of electronics packages. Failure mechanisms and design for reliability. Hands-on project experience on electronics packaging. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5234:

Emi and Noise Reduction Techniques and Filter Design

Theory and practice of electromagnetic interference (EMI) noise coupling; techniques for noise reduction; shielding, grounding and filtering. Limitations of circuit theory, parasitics in circuits and their physical origins, measurement of EMI to comply with government regulation. EMI problems and solutions to switching power supply applications. Design of EMI filter, magnetics design, eddy currents. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5244:

Advanced Power Conversion Techniques

High-frequency resonant, quasi-resonant, and multi-resonant power conversion techniques; zero-voltage and zero-current switching techniques in pulse-width modulation converters and inverters. Pulse-width modulation and frequency modulation; non-linear analysis techniques for resonant and soft-switching converters and inverters. Power factor correction rectifiers and distributed power systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4224 (UG) OR ECE 4224
Corequisite(s):

ECE 5254:

Power Converter Modeling and Control

Nonlinear modeling of power conversion circuit using discrete and average techniques analysis and design of voltage mode and current mode control; parallel module operation and system interactions; distributed power systems; time domain simulation and frequency domain measurement techniques.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4224 (UG) OR ECE 4224
Corequisite(s):

ECE 5264:

Advanced Power Electronics Laboratory

Study of advanced control and high frequency modeling of power converters; analysis and design of high-frequency power converters; analysis of high-frequency magnetic components; analysis and design of embedded power management solutions for distributed power systems.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5254
Corequisite(s):

ECE 5274:

Modeling and Control of Three-Phase PWM Converters

Power conversion principles for three-phase pulse-width modulation techniques, control and converters. Development of averaged models of three-phase rectifiers and inverters in stationary and rotating coordinates. Small-signal models in rotating coordinates and control design. Introduction of switching state vectors and different modulation schemes. Three-phase inverter and rectifier applications. Parallel and multi-level three-phase converters. Alternate years. Prerequisite or equivalent.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4224 (UG) OR ECE 4224
Corequisite(s):

ECE 5284:

Energy Harvest Circuit Design

Energy sources for energy harvesting. Equivalent circuits for various transducers including piezoelectric (PZT), electromagnetic generators, photovoltaic cells, and thermoelectric generators. Power management circuits (PMCs) and maximum power point tracking (MPPT) schemes for piezoelectric cantilevers. PMCs for electromagnetic and electrostatic generators, and photovoltaic modules. MPPT schemes for photovoltaic modules under full sun and partial shading. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5314:

Power System Operation and Control

A course dealing with modern power system operational and control problems and solution techniques. State estimation, contingency analysis, load-frequency control, and automatic generation control. Load flow analysis and external equivalents for steady-state operations.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4334 (UG) OR ECE 4334
Corequisite(s):

ECE 5324:

Power System Planning

A study of generation planning, bulk power supply systems, production costing analysis, and load forecasting. Dispersed generation. Electric power system reliability and stability.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4334 (UG) OR ECE 4334
Corequisite(s):

ECE 5334:

Transients in Power Systems

Wave propagation, wave propagation on multiconductor systems, lightning phenomena, grounding for protection against lightning, direct lightning strokes to overhead lines without and with shield wires, fundamental concepts of switching transients, switching surge phenomena, system performance under switching surges, dynamic overvoltages, performance of power apparatus under transient voltages, surge arresters, insulation coordination, electromagnetic transient programs (EMTP). Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5374G:

Adv Alternate Energy Systems

Electric energy from alternative energy sources including solar, wind, hydro, biomass, geothermal and ocean. Characteristics of direct conversion, electromechanical conversion, and storage devices used in alternative energy systems. Power system issues associated with integration of small-scale energy sources into the electricity grid. System level cost benefit analysis. Prerequisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5404:

Advanced Analog Integrated Circuit Design

Complementary Metal–Oxide–Semiconductor (CMOS) technology; Analog and mixed-signal Integrated Circuits (ICs) design, and techniques to analyze and optimize performance metrics, such as: speed, area, power and signal integrity; Clocking, interconnect and scaling issues of ICs; Op Amp and Comparator, Voltage References, Integrated Filter, analog to digital converter (ADC), digital to analog converter (DAC), and phase-locked loop (PLL); Computer Aided Design (CAD) tools – schematic, layout, extraction and circuit simulation; Advanced topics including ICs' high frequency performance issues, emerging nano-devices, advanced fabrication technologies, three dimension (3D) ICs, and neuromorphic computing. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5414 (CS 5264):

Advanced Linux Kernel Programming

Design and internal organization of the Linux operating system kernel. Kernel subsystems, boot process, memory management, process and thread model, scheduling, interrupt and exception handling, virtual file system and the concrete file system, block I/O and I/O scheduler, network stack, and device drivers. Modification of existing kernel code. Design, implementation, test, and evaluation of new kernel modules. Kernel and full software stack debugging techniques, and virtualization as an aid for operating system development and debug. Software engineering techniques to analyze, modify and run a large, complex open-source code base. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5424 (CS 5824):

Advanced Machine Learning

Algorithms and principles involved in machine learning; focus on perception problems arising in computer vision, natural language processing and robotics; fundamentals of representing uncertainty, learning from data, supervised learning, ensemble methods, unsupervised learning, structured models, learning theory and reinforcement learning; design and analysis of machine perception systems; design and implementation of a technical project applied to real-world datasets (images, text, robotics). Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5434:

Cyber-Physical Systems

Modeling formalism of Cyber-Physical Systems (CPS). Modeling of physical and cyber systems; software synthesis from these modeling formalisms; supporting operating systems and hardware architectures for CPS; critical requirements of CPS and their validation/verification; and CPS case studies. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5444:

Advanced Technological Singularity

Investigation, conceptualization and analysis of Technological Singularity -- the potential impact of true artificial machine intelligence on engineering and society. Historical perspectives. Barriers to whole brain emulation and the engineering of superintelligence. The role of consciousness in achieving true machine intelligence. Potential scenarios if superintelligence would come into being. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5454:

Optimization Techniques for Electrical and Computer Engineering

Convex optimization theory and algorithms and their application to electrical and computer engineering. Sparse optimization methods, eigen-decomposition techniques, the expectation-maximizing algorithms, stochastic optimization techniques, and special techniques relevant to large-scale optimization.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5605

Corequisite(s):

ECE 5464:

Applications of Machine Learning

Applications of Machine Learning (ML) for predictive data analytics. Probability for ML including conditional probability, the product and chain rule, and the Theorem of Total Probability. Data preparation for ML algorithms, normalization, cleaning, and imputation of missing values. Information-based learning using decision trees. Similarity-based methods, data classification and clustering. Probability-based learning, conditional probability and Bayes' theorem, and applications. Linear and logistic regression and optimization-based learning. Performance evaluation of ML systems. Artificial Neural Networks. Real-world applications of ML and case studies. Not for CPE-MS, EE-MS, CPE-PhD, or EE-PhD credit. May be taken for CPE-MEng or EE-MEng credit. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5480:

Cybersecurity and the Internet of Things

Cybersecurity principles and technologies motivated by the evolving ecosystem of Internet of Things (IoT): devices, operating systems, sensors, data storage, networking and communication protocols, and system services. IoT device and system security and privacy vulnerabilities, analysis, and attack mitigation techniques. Master of Information Technology (MIT) students only.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5484 OR CS 5044

Corequisite(s):

ECE 5484:

Fundamentals of Computer Systems

Fundamental principles and concepts of computer systems. Computer hardware; Boolean logic; number systems and representation; design and operation of digital logic; analysis of instruction set architectures and computer organization; and specification of data communication and networking standards. Master of Information Technology (MIT) students only. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5485:

Networks and Protocols

5485: Fundamental principles and concepts of computer networks; application, transport, network, and data link protocols. Contemporary and emerging networks; Internet protocols. Principles of quality of service, network security, and network management. 5486: Performance evaluation via analysis, simulation, and experimental methods of networks and network protocols. Wireless and mobile network technologies and protocols; wireless local area networks, cellular systems, sensor networks and the Internet of Things (IoT). Mobility in the

Internet and application support for mobility. Master of Information Technology (MIT) students only. Partially duplicates ECE/CS 5565-5566.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5484, CS 5044

Corequisite(s):

ECE 5486:

Networks and Protocols

5485: Fundamental principles and concepts of computer networks; application, transport, network, and data link protocols. Contemporary and emerging networks; Internet protocols. Principles of quality of service, network security, and network management. 5486: Performance evaluation via analysis, simulation, and experimental methods of networks and network protocols. Wireless and mobile network technologies and protocols; wireless local area networks, cellular systems, sensor networks and the Internet of Things (IoT). Mobility in the Internet and application support for mobility. Master of Information Technology (MIT) students only. Partially duplicates ECE/CS 5565-5566.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5485

Corequisite(s):

ECE 5494:

Innovation Pathways in Artificial Intelligence and Machine Learning

Convergence of digital technologies in networked devices, big data, and advanced breakthroughs in artificial intelligence (AI) and machine learning (ML). Meaning, theory, and construction of socio-technical systems. Analysis of technical aspects and opportunities of AI/ML systems in organizations. Technosystem due diligence of advanced AI/ML systems. Assessment of the viability of emerging technological solutions. Social impacts of disruptive change upon individuals, organizations, and society-at-large. Frameworks for the design and implementation of advanced AI/ML systems. Planning for the future of AI/ML. Master of Information Technology (MIT) students only.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5484 OR MGT 5804

Corequisite(s):

ECE 5504 (CS 5504):

Computer Architecture

Advanced computer architectures, focusing on multiprocessor systems and the principles of their design. Parallel computer models, programming and interconnection network properties, principles of scaleable designs. Case studies and example applications of pipeline processors, interconnection networks, SIMD and MIMD processors.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4504 (UG) OR ECE 4504

Corequisite(s):

ECE 5505:

Testing and Verification of Digital Systems

Various topics on digital circuit testing and verification. 5505: digital circuit testing including simulation, test pattern generation, design for testability, built-in-self-test, and diagnosis. Graduate standing in ECE is required. 5506: circuit verification including two-level and multi-level circuit verification, sequential circuit verification, model-checking simulation-based verification, and ATPG-based verification. Graduate standing in ECE required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECPE 4505

Corequisite(s):

ECE 5506:

Testing and Verification of Digital Systems

Various topics on digital circuit testing and verification. 5505: digital circuit testing including simulation, test pattern generation, design for testability, built-in-self-test, and diagnosis. 5506: circuit verification including two-level and multi-level circuit verification, sequential circuit verification, model-checking simulation-based verification, and ATPG-based verification. Graduate standing in ECE required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECPE 4505

Corequisite(s):

ECE 5510 (CS 5510):

Multiprocessor Programming

Principle and practice of multiprocessor programming. Illustration of multiprocessor programming principles through the classical mutual exclusion problem, correctness properties of concurrency (e.g., linearizability), shared memory properties (e.g. register constructions), and synchronization primitives for implementing concurrent data structures (e.g., consensus protocols). Illustration of multiprocessor programming practice through programming patterns such as spin locks, monitor locks, the work-stealing paradigm and barriers. Discussion of concurrent data structures (e.g., concurrent linked lists, queues, stacks, hash maps, skiplists) through synchronization patterns ranging from coarse-grained locking to fine-grained locking to lock-free structures, atomic synchronization primitives, elimination, and transactional memory. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4534 OR ECE 4550

Corequisite(s):

ECE 5514:

Design of Systems on a Chip

Current state of the art in the system-level design of Systems on a Chip. The focus is in hardware, scheduling, and applications at the highest levels of design. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4514 (UG) OR ECE 4514

Corequisite(s):

ECE 5534:

Electronic Design Automation

This course introduces graduate students to the various design automation artifacts, algorithms, and methodologies. It includes system level design languages, abstractions, models of computation, high level synthesis, modeling and model transformations, and simulation based validation. The course deals with state of the art design practices. It requires a solid back-ground in computer architecture, digital design, and proficiency in programming and modeling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4514 (UG) OR ECE 4514

Corequisite(s):

ECE 5544 (CS 5544):

Compiler Optimizations

Overview of compilation and compiler optimizations. Design and internal organization of the Low-Level Virtual Machine compiler infrastructure. Static Single Assignment. Data-flow analysis and techniques for reaching definitions, live variable analysis, and available expressions. Lattice theory and iterative algorithms for general frameworks. Non-separable dataflow analysis including constant propagation and folding, faint variable analysis, and points-to may/must analysis. Loop-invariant code motion and lazy code motion. Static Single Assignment construction and optimizations. Register allocation and coalescing. Pointer analysis using Anderson’s and Steensgaard’s algorithms, and liveness analysis of heap data. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5545:

Advanced VLSI Design

Advanced concepts in CMOS-based digital system are studied. The topics include implementation of special purpose structures for complex digital systems, automation and verification of the design process, and design for testability (5545); and design techniques for low-power design, power dissipation estimation, and application of low-power techniques in the different levels of the design hierarchy (5546).

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4540 (UG) OR ECE 4540

Corequisite(s):

ECE 5550G:

Advanced Real-Time Systems

Theory, algorithmic and protocol concepts, mechanisms, and implementations of real-time computer systems. Introduction to real-time systems, real-time scheduling, real-time synchronization, real-time operating systems kernels, and real-time programing languages. Design and analysis of real-time resource management algorithms (e.g., scheduling, synchronization), their implementations in production operating system kernels, experimental studies of those implementations, and real-time application development. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5554:
Computer Vision
Techniques for automated analysis of images and videos. Image formation, feature detection, segmentation, multiple view geometry, recognition, and video processing. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): null null

ECE 5560 (CS 5560):
Fundamentals of Info Security
Principles of information security and relevant mathematical concepts. Classical ciphers, relevant abstract algebra and number theory, symmetric-key ciphers, cipher modes of operation, and asymmetric-key ciphers. Cryptography and cryptosystems. Applications and standards relevant to network and computer security. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5564:
Wearable and Ubiquitous Computing
Issues in the design and use of wearable and ubiquitous computing systems. Topics covered include current research issues in system-level low power design, input/output devices, location and context-awareness, and networking. Students are expected to design, implement, and evaluate a wearable computing device or application.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4534 (UG) OR ECE 4550 (UG) OR ECE 4534 OR ECE 4550
Corequisite(s):

ECE 5565 (CS 5565):
Network Architecture and Protocols
5565: Principles and concepts of networking and protocols, with emphasis on data link, network, and transport protocols. Contemporary and emerging networks and protocols to illustrate concepts and to provide insight into practical networks including the Internet. Quantitative and qualitative comparisons of network architectures and protocols. 5566: Performance evaluation, design, and management of networks. Use of queuing and other analytical methods, simulation, and experimental methods to evaluate and design networks and protocols. Network management architectures and protocols. Graduate standing in EE, ECE, CS, or IT is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 4714 (UG) OR STAT 4714
Corequisite(s):

ECE 5566 (CS 5560):
Network Architecture and Protocols
5565: Principles and concepts of networking and protocols, with emphasis on data link, network, and transport protocols. Contemporary and emerging networks and protocols to illustrate concepts and to provide insight into practical networks including the Internet. Quantitative and qualitative comparisons of network architectures and protocols. 5566: Performance evaluation,d esign, and management of networks. Use of queuing and other analytical methods, simulation, and experimental methods to evaluate and design networks and protocols. Network management architectures and protocols. Graduate standing in EE, ECE, CS or IT is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5565 (UG) OR ECE 5565
Corequisite(s):

ECE 5580:
Cryptographic Engineering
Implementation of cryptographic operations and protocols in contemporary computing platforms. Mapping of cryptographic operations, evaluation and optimization of performance and implementation cost, analysis of security against brute- force cryptanalysis and implementation-level attacks, security-testing procedures, and architectures to support a trusted computing base.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5560 OR CS 5560

Corequisite(s):

ECE 5584 (CS 5584):

Network Security

Fundamentals of network security. Network security architecture, user and attacker perspective. Practical applications and security standards. Protocol design principles and their impact on computer and network security. Authentication systems. Email security. Firewalls and intrusion detection. Security for wireless systems. Pre: Graduate standing in CSA.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5585:

IT Security and Trust

5585: Fundamental Internet and computer security principles and applications; legal and privacy issues, risk analysis, attack techniques, intrusion detection concepts, basic computer forensics, and system and application security hardening techniques. 5586: Advanced security and trust concepts and implementation in wired and wireless computer networks and computer systems; malware defenses, impact of channel fragility, node mobility, cooperative functionality, and resource constraints on security and trust at the different layers of the Internet protocol stack. Pre: Graduate standing for 5585.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5586:

IT Security and Trust

5585: Fundamental Internet and computer security principles and applications; legal and privacy issues, risk analysis, attack techniques, intrusion detection concepts, basic computer forensics, and system and application security hardening techniques. 5586: Advanced security and trust concepts and implementation in wired and wireless computer networks and computer systems; malware defenses, impact of channel fragility, node mobility, cooperative functionality, and resource constraints on security and trust at the different layers of the Internet protocol stack. Pre: Graduate standing for 5585.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5585

Corequisite(s):

ECE 5590 (CS 5590):

System and Software Security

Secure software design, memory and file system security, operating system security for various platforms. Program classification, anomaly detection, malware detection and analysis. Technical challenges and problems in securing operating systems and software. Classic and modern algorithms, models, principles, and tools for system and application software security. Actual security examples.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CS 5560 OR ECE 5560

Corequisite(s):

ECE 5605 (BMES 5525):

Stochastic Signals and Systems

5605: Engineering applications of probability theory, random variables and random processes. Time and frequency response of linear systems to random inputs using both classical transform and modern state space techniques. 5606: Response of continuous and discrete time, linear and nonlinear systems to Gaussian and non-Gaussian random processes. Introduction to signal detection theory and optimal filtering (estimation) techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 4714 (UG) OR STAT 4714

Corequisite(s):

ECE 5606:

Stochastic Signals and Systems

5605: Engineering applications of probability theory, random variables and random processes. Time and frequency response of linear systems to random inputs using both classical transform and modern state space techniques. 5606: Response of continuous and discrete time, linear and

nonlinear systems to Gaussian and non-Gaussian random processes. Introduction to signal detection theory and optimal filtering (estimation) techniques.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5605 (UG) OR ECE 5605
Corequisite(s):

ECE 5620:

Advanced DSP and Filter Design

Advanced analysis, design, and realization of digital filters. Efficient Discrete Fourier Transform algorithm implementations, finite wordlength arithmetic, fixed point implementation, limit cycles, noise shaping, decimation and interpolation, multi-rate digital filter design, Hilbert transformers, analytic signal generation, basic adaptive filtering.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (ECE 4624 (UG), STAT 4714 (UG)) OR (ECE 4624, STAT 4714)
Corequisite(s):

ECE 5634:

Information Theory

Transmission of information over noisy channels. Measures of information and transmission channel capacity. Use of codes to improve the reliability of such transmission. Mathematical theory of information. Transmission at rates above channel capacity. Includes linear codes, error detecting and correcting codes, Hamming codes.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (STAT 4714 (UG), ECE 4634 (UG), ECE 5605 (UG)) OR (STAT 4714, ECE 4634, ECE 5604)
Corequisite(s):

ECE 5635:

Radar Systems Analysis and Design

5635: This graduate-level course is the first in a two-part sequence in radar analysis and design. It covers the theory and practice of radar systems used for detection, tracking and location of targets. Topics include measurement of range and velocity, pulse compression, design of radar transmitter, receivers and antennas. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5605
Corequisite(s):

ECE 5636:

Radar Systems Analysis and Design

5636: This graduate-level course is the second in a two-part sequence in radar analysis and design. It covers signal processing techniques used in pulsed radar systems. Topics include signal modeling, matched filter, frequency-modulated pulse compression waveforms, pulse Doppler processing, the Neyman-Pearson detection theory, constant false-alarm rate detection, beamforming and space-time adaptive processing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5635
Corequisite(s):

ECE 5644:

Game Theory for Communication Networks

Analysis and optimization of large-scale engineering systems and communication networks using game theory. Introduction to the basics of game theory and its two branches- noncooperative and cooperative games-with application to the design of emerging communication systems and networks. A comprehensive treatment of the basics of game theory and learning with communication networking examples drawn from various areas such as cellular networks, mobile ad hoc networks, and related fields. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5654:

Digital Communications II: Advanced Theory and Analysis

Fundamentals of the theory, design, and analysis of modern digital communication systems. Representation of signal in digital form. Design and analysis of digital modulation formats and receivers using signal space techniques. Combining error correction techniques with digital modulation. Viterbi algorithm for maximum likelihood sequence estimation. Equalization and adaptive equalization. Fading channels and

diversity techniques.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (ECE 4634 (UG), ECE 5605 (UG)) OR (ECE 4634, ECE 5605)
Corequisite(s):

ECE 5660:

Spread Spectrum Communications

Major topics include: direct sequence and frequency hopping methods, synchronization, resistance to jamming, low probability of detection, spreading codes and their generation, system performance, RAKE receivers, Code Division Multiple Access, cellular CDMA applications, wireless LAN applications, as well as commercial and military applications.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (ECE 4634 (UG), ECE 5605 (UG)) OR (ECE 4634, ECE 5605)
Corequisite(s):

ECE 5664:

Cellular Communication Systems

Fundamental theory, design tradeoffs and practical issues of high capacity wireless communications systems. Trunking, RF propagation, frequency reuse, and legacy and emerging radio communications systems, including Long Term Evolution (LTE) cellular networks.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5605
Corequisite(s):

ECE 5674:

Software Radios: Modern Radio Engineering

An introduction to software radios, devices that can be programmed to work with a variety of different radios. The course will cover the following topics: software radio architectures, existing software radio efforts, a review of basic principles, an analysis of receiver operation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (ECE 4624 (UG), ECE 4634 (UG)) OR (ECE 4624, ECE 4634)
Corequisite(s):

ECE 5704 (ME 5704):

Robotics and Automation

Automation, mechatronics, robot technology, kinematics, dynamics, trajectory planning, and control of two-dimensional and spatial robots; robot programming; design and simulation of robotic devices. Laboratories associated with robot forward/inverse kinematics, task planning, velocity kinematics, force rendering, control, haptics, mobile robotics, mapping/localization, computer vision and path planning. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 5714:

Robust Estimation and Filtering

An introduction to the analysis and design of maximum likelihood and robust estimators and filters. Maximum likelihood estimation theory: consistency, asymptotic efficiency, sufficiency. Robust estimation theory: qualitative robustness, breakdown point, influence function, change-of-variance function. Robust estimators: M-estimators, generalized M-estimators, high-breakdown estimators. Robust estimation of ARIMA models; Robust Kalman filter. Long memory processes: Hurst parameter estimation; parameter estimation of fractional ARIMA models. Applications to image and speech processing, communications, radar systems, and electric power systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5605
Corequisite(s):

ECE 5734 (ME 5584) (AOE 5734):

Convex Optimization

Recognizing and solving convex optimization problems. Convex sets, functions, and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5744 (AOE 5744) (ME 5544):

Linear Systems Theory

Advanced introduction to the theory of time-varying and time-invariant linear systems represented by state equations; solutions of linear systems, uniform stability and other stability criteria, uniform observability and controllability, state feedback and observers. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 OR ECE 4405 (UG) OR ECE 4624 (UG) OR ECE 4624 OR ECE 4634 (UG) OR ECE 4634 OR ME 4504 (UG) OR ME 4504 OR AOE 4004 (UG) OR AOE 4004

Corequisite(s):

ECE 5754 (AOE 5754) (ME 5554):

Applied Linear Systems

Develop an applied understanding of state-space representations for linear time invariant multi-input multi-output dynamic systems in both time domain and frequency domain. Introduction to modern state-space control methods; state feedback and output feedback. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 OR ECE 4624 OR ECE 4634 OR ME 4504 OR AOE 4004 OR ECE 4405 (UG) OR ECE 4624 (UG) OR ECE 4634 (UG) OR ME 4504 (UG) OR AOE 4004 (UG)

Corequisite(s):

ECE 5764 (ME 5564) (AOE 5764):

Applied Linear Control

Analysis and design of sampled-data systems, extraction of discrete-time dynamic models from experimental data, and implementation of dynamic compensators on digital processors. In-depth design experience with LQR optimal control and an introduction to Kalman filtering. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5744 OR ECE 5754 OR ME 5554 OR ME 5544 OR AOE 5744 OR AOE 5754

Corequisite(s):

ECE 5774 (AOE 5774) (ME 5574):

Nonlinear Systems Theory

Introduction to the theory of systems of coupled, nonlinear, time-varying ordinary differential equations: existence and uniqueness of solutions; continuous dependence on parameters; stability of equilibria and stability analysis techniques; input-to-state stability; input-output stability; nonlinear design techniques including input-state and input-output feedback linearization, backstepping, and sliding mode control. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5805:

Graduate Design Project and Report

Industry-like two semester, team-based design experience. Design and implement solutions to meet multiple realistic constraints; design to incorporate appropriate engineering standards. A specific, complex engineering design problem taken from problem definition to product realization and testing. Written and oral communication, professional development, project management, and working within a team. 5805: Determine and formulate an engineering problem with multiple realistic constraints. Generate and select design alternatives. Apply design and analysis methods to develop, evaluate, and communicate a detailed project design. 5806: Implement and refine the project design from ECE 5805. Test, analyze, document, and deliver the resulting project outcomes. A final oral and written examination that satisfies the Master of Engineering (MEng) program requirements. Pre: Graduate standing in Electrical Engineering and Computer Engineering Master of Engineering degree students only for 5805; 5805 (B) for 5806.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5806:

Graduate Design Project and Report

Industry-like two semester, team-based design experience. Design and implement solutions to meet multiple realistic constraints; design to incorporate appropriate engineering standards. A specific, complex engineering design problem taken from problem definition to product realization and testing. Written and oral communication, professional development, project management, and working within a team. 5805: Determine and formulate an engineering problem with multiple realistic constraints. Generate and select design alternatives. Apply design and analysis methods to develop, evaluate, and communicate a detailed project design. 5806: Implement and refine the project design from ECE 5805. Test, analyze, document, and deliver the resulting project outcomes. A final oral and written examination that satisfies the Master of Engineering (MEng) program requirements. Pre: Graduate standing in Electrical Engineering and Computer Engineering Master of Engineering degree students only for 5805; 5805 (B) for 5806.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5805

Corequisite(s):

ECE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ECE 5944:

Seminar

To acquaint graduate students with recent and current research results and trends and to introduce researchers to students performing important work in Electrical and Computer Engineering.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ECE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ECE 6104:

Advanced Topics in Electromagnetics

Advanced topics of current interest in Electromagnetic Engineering. Topics are selected from current technical literature. May be repeated for credit.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s):

ECE 6115:

Antenna Theory and Design I,II

6115: Antenna systems and arrays: antennas in systems, antenna synthesis array fundamentals, array excitation and mutual impedance, waveguide slot arrays, microstrip antennas, microstrip elements, microstrip planar and conformal arrays, numerical methods for antenna analysis, Method of Moments and FDTD, antenna measurements, phased arrays. 6116: Reflectors and aperture antennas: aperture theory, analytical and computer-based designs, reflector antenna fundamentals, numerical methods for reflector analysis, general formulation of GO, PO, GTD, PTD and UTD methods, Gaussian beams, reflector optic configurations, prime-symmetric, Gregorian, Cassegrain and prime-offset reflector systems, analysis of strut scattering, aperture blockage, spillover, G/T analysis, measuring and commissioning reflector systems, reflector feed array, focal plane arrays, defocused arrays.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s): null null

ECE 6116:

Antenna Theory and Design I,II

6115: Antenna systems and arrays: antennas in systems, antenna synthesis, array fundamentals, array excitation and mutual impedance, waveguide slot arrays, microstrip antennas, microstrip elements, microstrip planar and conformal arrays, numerical methods for antenna analysis, Method of Moments and FDTD, antenna measurements, phased arrays. 6116: Reflectors and aperture antennas: aperture theory, analytical and computer-based designs, reflector antenna fundamentals, numerical methods for reflector analysis, general formulation of GO, PO, GTD, PTD and UTD methods, Gaussian beams, reflector optic configurations, prime-symmetric, Gregorian, Cassegrain and prime-offset reflector systems, analysis of strut scattering, aperture blockage, spillover, G/T analysis, measuring and commissioning reflector systems, reflector feed array, focal plane arrays, defocused arrays.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s): null null

ECE 6124:

Advanced Numerical Electromagnetics

A thorough coverage of numerical methods for electromagnetics, including topics on the foundations of function theory, Greens functions, mode-matching, and numerical expansion techniques in both the time and frequency domains. Emphasis will be placed on the method of moments and the finite element method, with development of the theoretical foundations of these methods. Alternate year course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5106 (UG) OR ECE 5106

Corequisite(s):

ECE 6154:

Photonic Devices and Systems

Electromagnetic analysis of guided-wave optical devices and systems, including transmission properties of optical fibers, photonic crystal waveguides, grating structures, and coupled-wave components; soliton propagation in fibers; Erbium-doped and Raman fiber amplifiers; semiconductor light sources and photodetectors; wavelength-division multiplexed systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5105

Corequisite(s):

ECE 6174 (CS 5504):

Computational Plasma Dynamics

Computational techniques for investigating processes in plasmas over a broad range of spatial and temporal scales. Investigation of physical processes including electrodynamics, waves and turbulence, space propulsion, spacecraft environmental effects and various laboratory applications. Computational techniques including full Particle-in-Cell (PIC), hybrid (fluid-electron, PIC ion), magnetohydrodynamics MHD and two-fluid methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5174 OR AOE 5174

Corequisite(s):

ECE 6204:

Advanced Topics in Electronics

Advanced topics of current interest in electronics engineering, with particular emphasis on microelectronics. Topics are selected from current technical literature to stress and reflect important potential areas in the electronic field. These topics include multichip modules, electronic packaging, microwave packaging, modeling simulation and evaluation of high speed devices, wideband characterization of electronic materials and multilayer structures, time and frequency domain measurement techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 6214:

Optoelectronic Devices

Principles of light generation and detection, operation, and design of state-of-the art optoelectronic and photonic devices. Advanced treatment of the operating principles of semiconductor optoelectronic devices with direct comparison to experimental data reported in the literature.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5200

Corequisite(s):

ECE 6304:

Advanced Topics in Power

Advanced topics of current interest in Electric Power Engineering. Topics are selected from current technical literature. Certain topics may be repeated.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 6314:

Advanced Instrumentation in Power Systems

Role of advanced instrumentation in monitoring, control and protection applications in power systems. Effects and limitations of instrument transformers, signal conditioning circuits, analog to digital (A/D) converters and Digital Signal Processing (DSP) chips, time synchronization and sampling, output circuits and devices, and communication channels. Fast Fourier Transform (FFT), protection algorithms, phasor and frequency measurements.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5314

Corequisite(s):

ECE 6334:

Computational Methods in Power Engineering

This course is designed to introduce various linear and nonlinear program based optimization algorithms that are specially suited for the design, analysis and operation of electric power systems, power processing devices, machines, and transformers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5324 (UG) OR ECE 5324

Corequisite(s):

ECE 6354:

Power System Dynamics and Control

Dynamic modeling, stability analysis, and control of multi-machine power systems. Single-machine dynamic modeling, multi-machine dynamic modeling, network differential-algebraic equations and solution methods, small-signal stability analysis, and design of power system stabilizers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5314

Corequisite(s):

ECE 6504:

Advanced Topics in Computer Engineering

Advanced topics of current interest in computer engineering which are

taken from current research topics and/or technical publications. Prerequisites at 5000 level dependent on specific topics.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ECE 6524 (AOE 5754) (ME 5554):

Deep Learning

Advanced concepts in Machine Learning and Deep Learning. Models (multi-layer perceptrons, convolutional neural networks, memory networks), learning algorithms (backpropagation, stochastic sub-gradient descent, dropout), connections to structured predictions (Boltzmann machines, unrolled belief propagation), and applications to perception and Artificial Intelligence (AI) problems (image classification, detection, and segmentation; image captioning; visual question answering; automatic game playing).
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5424 (UG) OR ECE 5424G (UG) OR CS 5824 (UG)
Corequisite(s):

ECE 6554:

Advanced Computer Vision

Current and state-of-the-art trends in computer vision, particularly in object recognition and scene understanding. Application of approaches in computer vision to various automatic perception problems. Strengths and weaknesses of computer vision techniques. Open questions and future research directions. Pre: 5554.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5554
Corequisite(s):

ECE 6564 (CS 6564):

Multimedia Networking

This course examines and explores recent advances in multimedia networking technologies. Major topics include multimedia compression and standards, quality of service (QoS) support mechanisms and protocols, performance analysis, network calculus, IP multicasting, Internet multimedia applications, and multimedia transport over wireless networks.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5565 (UG) OR ECE 5565
Corequisite(s):

ECE 6604:

Advanded Topics in Communications

Advanced topics of current interest in communications, which are taken from publications and industrial information.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5654 OR ECE 5655
Corequisite(s):

ECE 6634:

Multi-Channel Communications

In-depth study of modern multi-channel communications techniques, primarily multi-antenna systems (known as multiple input multiple output or MIMO) and Orthogonal Frequency Division Multiplexing (OFDM). Specifically the course examines multi-antenna techniques such as transmit and receive diversity, beamforming (including eigen-beamforming), and spatial multiplexing. Within the area of OFDM we examine modulation/demodulation, carrier bit loading, mitigating multipath, frequency-domain equalization, peak to average power reduction, and frequency offset mitigation. As time permits we will also investigate a third multi-channel technique known as multi-user scheduling or packet access networks.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5605, ECE 5654
Corequisite(s):

ECE 6744 (AOE 6744) (ME 6544):

Linear Control Theory

Advanced introduction to the theory of optimal control of time-varying and time-invariant linear systems; Solutions to the linear-quadratic regulator, optimal filtering, and linear-quadratic-gaussian problems; Robustness analysis and techniques to enhance robustness of controllers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5744 OR ECE 5754 OR ME 5544 OR ME 5554 OR AOE 5744 OR AOE 5754

Corequisite(s):

ECE 6774 (ISE 6574) (AOE 6774) (ME 6574):

Adaptive Control Systems

Introduction to the theory and methodology used to design adaptive controllers for uncertain systems, addressing issue such as input constraints, disturbance rejection, partial measurements, and robustness.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)

Corequisite(s):

ECE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ECE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENGINEERING EDUCATION

Jennifer Case, Head

Emeriti Faculty: Richard Goff;

Professors: Jennifer Case; David Knight; Vinod Lohani; Holly Matusovich; Elizabeth McNair; Marie Paretti; Bevlee Watford;

Associate Professors: Diana Bairaktarova; Jacob Grohs; Walter Lee; Jeremi London; Homero Murzi Escobar; Sarah Rodriguez; Qin Zhu;

Assistant Professors: Mark Huerta; Andrew Katz; Dayoung Kim; Nicole Pitterson; Susan Sajadi;

Graduate Contact: knott@vt.edu

Graduate Site: http://enge.vt.edu/graduateprogram.html

Graduate Student Manual: https://enge.vt.edu/content/dam/enge_vt_edu/grad-program/ENGE%20Graduate%20Manual.pdf

The Engineering Education (ENGE) graduate program at Virginia Tech is ideal for students who are interested in becoming leaders in innovation and catalysts for change in society through rigorous research in the field of engineering education. The program strives to prepare students who are interested in a variety of professional goals, including engineering faculty positions in universities of all types, students who wish to pursue careers in policy, and students with a strong interest in educational research, corporate training management, university assessment or university administration. The cross-disciplinary PhD program is designed specifically to prepare graduates for careers across the entire range of engineering education. The inherent flexibility of the program allows students to tailor their curriculum and research to prepare them to achieve their goals in engineering education. In addition to the PhD, the Virginia Tech Department of Engineering Education also offers a 12-credit Graduate Certificate. The ENGE Graduate Certificate course offerings overlap significantly with those of the Engineering Education PhD and the Graduate School's Professoriate Certificate.Our Mission: Preparing scholars to advance knowledge and address significant challenges facing engineering education.

SPECIAL FACILITIES

Five key areas of research strength characterize VT Engineering Education: 1) Diversity, equity, and inclusion, 2) Engineering workforce development, 3) Inter/transdisciplinary collaboration and development of systems thinking skills, 4) Application of educational research to practice, and 5) Outreach and engegement with K12 schools and community/regional institutional partners, in particular in rural settings.

ACE(D) Lab

Through real-world engineering applications, the Abilities, Creativity, and Ethics in Design, ACE(D), Lab experiential learning research crosses disciplines including engineering, psychology and the learning sciences, as we uncover how individual performance is influenced by abilities, personal interests and direct manipulation of physical and virtual objects. Led by Dr. Diana Bairaktarova, the ACE(D) Lab at Virginia Tech is dedicated to engineering and design education research and the engineering learner. Our interdisciplinary research focuses on the following three lines of inquiry: Using innovative technologies to study novel user interfaces, virtual and augmented learning and working environments that encompass human aspects at the cognitive, eye-tracking and sensory-motor levels. Investigating the role of individual aptitudes and abilities in performing and learning engineering through psychometric instruments and psychological interventions. Adopting design thinking as a philosophy (inspiration, ideation, and quick prototyping) to investigate user-centered design, empathic design and design for social innovation.

Complexities | Communities | Change Lab

The Complexities, Communities, Change (EC)3 Lab is directed by Dr. Jacob Grohs. His team of students and faculty are committed to research, teaching, and outreach within three interconnected areas: Embracing Complexities: We love wicked problems, coupled systems, socio-ethical complexities, and trying to make sense of all sorts of messy data. Engaging Communities: We believe good things can happen when diverse stakeholders come together around shared goals. We think often about our responsibility to others outside of our field and academia and we aim to be willing and committed partners. Enacting Change: We are motivated by pressing challenges within the education system and broader society and we strive for positive change. this means we must sometimes work hands-on with stakeholders to achieve what we envision.

Critical Frontiers Research Group

The Critical Frontiers Research Group comprises a group of students who are engaged with Dr. Jenni Case on their research journeys. Some are advised by her, some have her on their committee, some are working with her as graduate assistants, and others just choose to connect in the weekly Research Group meetings.We chose the title ‘Critical Frontiers’ to represent their research interests as each of them is seeking in some way to push the boundaries in engineering education or higher education research. Many of us are interested in comparative educational questions; most of us are interested in culture and its relation to engineering education. We are open to critical approaches and we are interested in the sociology of education.

DEEP Lab

The vision of the Virginia Tech Data Enhanced Educational Practice (DEEP) Lab is to serve as one of the world's leading research shops for promoting a systems view of engineering education with an explicit mission to improve the efficiency, effectiveness, and inclusion of the field. Aligned with Virginia Tech's Data Anayltics and Decision Sciences Destination Area, the VT DEEP Lab uses large-scale quantitative data to diagnose problems, identify opportunities and solutions, and enact organizational change by connecting research to policy and practice. Adopting this macro-scale, systems perspective to inform organizational decision-making has helped our team serve as active organizational change agents trhough collaborative projects, locally, nationally, and internationally. Dr. David Knight, Director

ECLIPS Lab

The Engineering Competencies, Learning, and Inclusive Practices for Success (ECLIPS) Lab, is directed by Dr. Homero Murzi. This group focuses on understanding how to create contemporary, inclusive, data-driven pedagogical practices to develop effective learning environments that better support engineering students, especially those from traditionally marginalized populations (e.g., Latinx, Native American, International students) and to prepare them for the complexities of the engineering workforce. This diverse community critically explores issues in engineering education and higher education, focusing on the following areas: Competencies, Learning, and Inclusive Practices. They value international perspectives and seek to expand their research agenda in ways that include international collaborators.

ELITE Research Group

The Education, Learning, Identity and Transfer in Engineering Research Group (ELITE)- directed by Dr. Nicole Pitterson, engages in research aimed at creating, supporting and sustaining engineering learning environments, formal and informal, that are designed to provide students with relevant knowledge, skills and attitudes necessary to be successful in their course of study and future professions. Our research seeks to answer the following core questions: How do we assess learning formally and informally in engineering (STEM)? How we design and innovate learning environments? How we support the development of students’ identity and sense of belonging in engineering? What mechanisms can be best leveraged to optimize transfer of learning? How do we use instructional practices to foster cognitive engagement and conceptual understanding?

GUIDE Research Group

GUIDE is committed to exploring, understanding, and elevating the lived experiences of engineers, engineering students, and prospective engineering students from historically oppresses communities. Through our work, we aim to advance the: Support of engineers and engineering students as the navigate existing work and learning environments. Education of engineering students and faculty about pervasive systems of oppression and the relevance of social issues to engineering work and practices. Empowerment of engineers who wish to actively disrupt oppressive systems and practices through their application of engineering tools and processes. Transformation of engineering education to make it more equitable, accessible, and inclusive. Dr. Walter Lee, Director

IDEEAS Lab

The Improving Decisions in Engineering Education Agents and Systems (IDEEAS) lab is a research Lab directed by Dr. Andrew Katz. Our work is driven by one overarching question: How can we use data to support decisions from the individual level up through the organiational level in order to achieve better societal outcomes through engineering education? We use large-scale, multimodal data to focus on topics ranging from environmental education in engineering to ethical decision making.

LabVIEW Enabled Watershed Assessment System Lab (LEWAS Lab)

The Learning Enhanced Watershed Assessment System (LEWAS) is a unique outdoor lab on Virginia Tech campus that integrates hardware and software components to monitor high frequency water (quality and quantity) and weather data from a site on Webb branch that flows through the campus. This lab has been integrated into various engineering courses at Virginia Tech and Virginia Western Community College and also supports research activities of graduate (PhD & MS) and undergraduate students. Currently, the lab hosts two projects funded by the National Science Foundation.Dr. Vinod Lohani, Director

RISE Research Group

The Research's Impact on Society and Education (RISE) Research Group is directed by Dr. Jeremi London. RISE is a diverse team of mixed methods researchers investigating the impact of research on society and education while simultaneously making an impact on STEM education through research.

SMILE Research Group

The Studies of Motivation and Identity in Learning Engineering (SMILE) group is directed by Dr. Holly Matusovich. This group engages in research and outreach to all levels of learners from pre-kindergarten through academic and industry workforces. We aim to inform, support, and create learning environments that encourage and enable broad participation in engineering majors and careers. We use motivation-and identity-related theories to examine ways to break down barriers, create opportunities, and engage all stakeholders (students, parents, teachers, co-workers) in thoughtful teaching and learning processes.

Virginia Tech Engineering Communications Center (VTECC)

VTECC integrates the professional and the technical to create a new kind of engineer. The Center brings faculty, students, and professionals together to explore, design, practice, and teach communication and collaboration in support of engineering work. Our lab provides a creative think space for engineering students and faculty to break through disciplinary molds and collaborate across boundaries to drive innovation. Dr. Marie Paretti, Director

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

PhD students must take a minimum of 90 total credits beyond the Bachelor's degree, submitted on a program of study subject to approval by the student's advisory committee. Curricular Requirements: Dissertation: 30 credits min. Engineering Education core courses: 8 credits Engineering Education Practical Applications: 3 credits Engineering Education Research Methods: 3 credits Engineering cognate: 12 credits Social Science cognate: 12 credits Electives: 9 credits Engineering Education Seminar: 4 credits ENGE & 1 credit GSSME Required Milestones and Examinations: Qualifying Examination Preliminary Examination PhD Research Proposal Progress Report Final Examination (Defense) Additional Information: At least 9 credits (ENGE or non-ENGE) will be at the 6000 level relevant to the student's research. At least 3 credits of Qualitative Research Methods and 3 credits of Quantitative Research Methods must be completed (3 credits must be in ENGE). Up to 30 credits from a Master's degree may be counted toward the PhD at the discretion of the student's advisory committee. More detailed information regarding degree requirements is available in the Engineering Education Graduate Manual.

GRADUATE COURSES (ENGE)

ENGE 5214:

Issues in Engineering Education

Current issues in Engineering Education (e.g., broadening participation, transformative practice, teaching and learning, emerging issues). Critical questions surrounding fundamental issues and approaches to engineering education research and practice. Pre: Graduate standing in College of Engineering.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5224:

Disciplinary Literacy: Theorizing and Writing in Engineering Education

Communicating engineering education research via writing. Reading and synthesizing existing research. Common genres and rhetorical patterns in the field. Theory in engineering education research. Common paradigms and theoretical frameworks. Writing as a means to engage in theorizing. Effective writing and editing practices. Ethical responsibilities of writers. Pre: Graduate standing in College of Engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5304:

Graduate Student Success in Multicultural Environments

Socialization to the graduate student environment. Strategies for entering an effective mentee-mentor relationship. Virginia Techs diversity and inclusion values. Focus on strategies for (1) facilitating clear communication with advisors, peers, or undergraduate mentees; (2) working within a culturally diverse environment; and (3) upholding ethical research practices. Pre: Graduate standing in the College of Engineering. Pass/Fail only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5504:

Practicum in the Engineering Classroom

Preparation for and practical experience as a teacher in the engineering classroom. Student must have primary responsibility for a class, workshop, or laboratory. Design and presentation of plans, lectures, workshops, and laboratories in the engineering classroom. Discussion, review, and evaluation of performance by senior faculty and discussion with peer group. May be repeated. Graduate standing, and completion of 6 credits of ENGE or related coursework with consent of instructor required.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5514:

Applied Design and Assessment of Educational Experiences in Engineering

Using research, bridge theory and practice to effectively design and assess educational experiences in engineering. Contemporary learning theories and evidence-based practices for effective and equitable education and evaluation in engineering across a range of levels (e.g., higher education, K-12, industry training) and contexts (e.g., formal courses and programs, informal co-curricular or extra-curricular programs, outreach experiences). Systematic design principles for aligning expected learning outcomes, assignments and activities, teaching and feedback practices, and assessment and evaluation tools. Specific attention to issues of equity and inclusion.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ENGE 5214

Corequisite(s):

ENGE 5604:

Engineering Education Research Methods

This course introduces methods and considerations specific to research in engineering education. Quantitative, qualitative and mixed methods are discussed as well as measures of research quality. Students will learn to design and critique engineering education research quality. Students will learn to design and critique engineering education research that addresses standards of rigor and quality. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5704:

Engineering Education Graduate Seminar

This course is designed to bring contemporary issues in engineering education research into the classroom. Experts from academia, industry, and the corporate world will be invited to make presentations on engineering education research issues, recruitment of minorities, retention issues, technology integration into engineering curricula, distance learning, engineering content into K-12 curricula, learning theories, engineering education policy issues, etc. In addition, graduate school procedures relevant to various graduate programs in the ENGE department will be explained. Altogether the course will include a minimum of 11 seminar presentations. Students will learn to critique engineering education research presentations and will demonstrate knowledge of contemporary issues in engineering education research. May be repeated 3 times with different content for a maximum of 4 credit hours. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5714:

Topics in Engineering Education Research Methods

Topics in engineering education research methods. Explorations of current and emerging methods used in engineering education research. Adapting methods used in other fields for engineering education audiences. Implications for future research. May be repeated up to three times with different topics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ENGE 5604

Corequisite(s):

ENGE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ENGE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENGE 6614:

Quantitative Data Analysis for Research in Engineering Education

Quantitative analysis methods for engineering education research. Key concepts in statistics including correlation, regression, t-tests, analysis of variance, and cluster and factor analysis. Organizing and manipulating data, interpreting and communicating findings from quantitative analysis, application to engineering education research. Use of statistical computing software such as R.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ENGE 5604

Corequisite(s):

ENGE 6624:

Qualitative Data Analysis for Research in Engineering Education

Qualitative data collection and analysis techniques, data collection and organization strategies, evaluation of data quality, systematic analysis of qualitative data regularly encountered in engineering education research, design of qualitative research studies, reporting qualitative research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ENGE 5604

Corequisite(s):

ENGE 6714:

Topics in Engineering Education Research and Practice

Topics in engineering education. Explorations of current and emerging topics relevant to engineering education research and professional practice. Historical and contemporary perspectives on current conversations within engineering education. Implications for research and practice. May be repeated up to three times with different topics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ENGE 5214, ENGE 5604

Corequisite(s):

ENGE 6974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ENGE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENGINEERING MECHANICS

Jennifer Wayne, Head

Emeriti Faculty: Norman Dowling; John Duke; John Grant; Zafer Gurdal; Muhammad Hajj; Scott Hendricks; Dr. Edmund Henneke; Robert Jones; Luther Kraige; Ronald Kriz; Kenneth Reifsnider; Mahendra Singh; Demetrios Telionis;

Professors: Romesh Batra; Jonathan Black; Jeffrey Borggaard; Scott Case; Rafael Davalos; Raffaella De Vita; David Dillard; Thomas Dingus; Stefan Duma; Robert Gourdie; Rakesh Kapania; Roop Mahajan; Steven McKnight; Rolf Mueller; Alexey Onufriev; Mark Paul; Rui Qiao; Robin Queen; Saad Ragab; Thanassis Rikakis; Shane Ross; David Schmale; Gary Seidel; John Socha; Mark Stremler; Danesh Tafti; Saied Taheri; Pamela VandeVord; Jennifer Wayne; Craig Woolsey;

Associate Professors: Nicole Abaid; Bahareh Behkam; Jonathan Boreyko; Michael Bortner; John Chappell; Zachary Doerzaph; Hosein Foroutan; Yao Fu; Christine Gilbert; Scott Huxtable; Andrew Kemper; Yong Lee; Suyi Li; Majid Manteghi; James McClure; Jennifer Munson; Michelle Olsen; Miguel Perez; Steven Poelzing; Steven Rowson; Anne Staples; Costin Untaroiu; Scott Verbridge; Vincent Wang; Robert West;

Assistant Professors: Alan Asbeck; Oumar Barry; Caitlyn Collins; John Domann; Netta Gurari; Aiguo Han; Sohan Kale; Justin Kauffman; Oleg Kim; Arina Korneva; John Palmore; LaDeidra Roberts; Shima Shahab; Alexandrina Untaroiu; Eli Vlaisavljevich;

Clifton C. Garvin Professor: Romesh Batra;

Reynolds Metal Professor: Scott Case;

Adhesive & Sealant Science Professor: David Dillard;

John R. Jones III Faculty Fellow: Bahareh Behkam; Jonathan Boreyko; Rui Qiao;

L. Preston Wade Professor: Rafael Davalos;

Norris and Laura Mitchell Professor of Aerospace Engineering: Rakesh Kapania;

Kevin P. Granata Faculty Fellowship: Robin Queen;

Harry C. Wyatt Professor, ICTAS Director: Stefan Duma;

N. Waldo Harrison Professor: Pamela VandeVord;

Newport News Shipbuilding Professor: Thomas Dingus;

Kendall and Laura Hendrick Junior Faculty Fellow: Eli Vlaisavljevich;

William S. Cross Professor: Danesh Tafti;

Lewis A. Hester Chair In Engineering: Roop Mahajan;

Professor of Practice: Andre Muelenaer;

Samuel Herrick Professor: John Socha;

General Contact: emgradinfo@vt.edu

Graduate Site: https://beam.vt.edu/graduate/mechanics.html

The Engineering Mechanics (EM) program provides a strong foundation and interdisciplinary framework for the discovery, development, transfer, and implementation of knowledge in the areas of mechanics of materials and material systems, fluid mechanics, dynamics and vibration, biomechanics, and computational and experimental methods. The Department of Biomedical Engineering and Mechanics (BEAM), home to the EM program, is fully committed to providing an educational environment that emphasizes fundamental understanding, high-quality teaching, frontier-level research, innovation, and service to the professional mechanics community. Instilling EM graduates with a rigorous background and a highly flexible professional perspective enables them to pursue successful careers in a variety of engineering industries, in research environments, and in higher education. Engineering Mechanics graduates teach and conduct research in academic departments across the nation and around the world; start up, lead, and work in a breadth of domestic and international companies and government laboratories; serve as science and technology advisors to local, regional, and federal agencies; hold leadership positions in professional societies; and actively promote the role and value of engineering science in the technological competitiveness of the Commonwealth of Virginia and our nation.

SPECIAL FACILITIES

The Engineering Mechanics graduate program has well-equipped research and teaching facilities on the Blacksburg campus for each of the supported research areas. Approximately 40,000 square feet of space supports program activities in Norris Hall, Kelly Hall, and several of the surrounding buildings.

Engineering Mechanics research groups

To view an up-to-date list all of faculty affiliated with the Engineering Mechanics program and their associated groups and facilities, visit https://beam.vt.edu/graduate/mechanics.html. Engineering Mechanics research groups include: Adhesion Mechanics Laboratory: David Dillard The Adhesion Mechanics Laboratory focuses on the mechanical behavior of polymeric materials and components, with a special emphasis on the fracture behavior and durability of adhesive bonds. Using fracture mechanics, viscoelasticity, and stress analysis tools, the group has been involved in a variety of federally and industrially-funded research programs to characterize behavior, develop constitutive relationships, and predict damage and durability response. Of recent interest has been adhesive bond fracture studies for automotive applications, fuel cell durability test methods and assessments, and characterization of adhesives, sealants, hydrogels, and membranes for a range of applications. Applied Interdisciplinary Research on Flow Systems (AIRFlowS) Lab: Hosein Foroutan, PI In the Applied Interdisciplinary Research on Flow Systems (AIRFlowS) Lab, we study a wide range of environmental, geophysical, and biological flow systems that are diverse in nature, scale, and physics. With a synergistic blend of numerical simulations, theory, experiments, and observations we characterize the transport of momentum, energy, and pollutants (chemicals, pathogens, allergens, and toxins) in these systems. Our research is highly interdisciplinary and integrates the knowledge of fluid dynamics, computational mechanics, atmospheric and environmental sciences, and aerosol sciences. The AIRFlowS Lab is led by Dr. Hosein Foroutan in the Department of Civil and Environmental Engineering. The Batra Group: Romesh Batra, PI The Batra Computational Mechanics Laboratory at Virginia Tech specializes in the development of mathematical and computational models of nonlinear and multi-physics phenomena that involve thermal, mechanical, viscous and electrical effects in elastic (e.g., rubber like, and biological materials), elastic-plastic (e.g., ceramics, metals, polymers), and thermo-visco-elasto-plastic materials under extreme loads such as those caused by improvised explosive devices and slamming of a boat into water (i.e., fluid-structure interaction). The group studies the initiation and progression of damage and failure in monolithic and composites including sandwich structures with fiber-reinforced face sheets and functionally graded materials/structures. Bioelectromechanical Systems Laboratory: Rafael Davalos, PI Bioelectromechanical Systems is a cross disciplinary field that combines engineering and science from the nano to the macro level. In our laboratory, we have developed technology for tissue viability detection, picoliter sample management, and imaging for molecular medicine. Using electrical feedback to perform complex procedures in biotechnology with precision and control, we have established robust methods for single cell analysis, selective cell concentration, and cancer therapy. Bio-Inspired Engineering Lab: Jake Socha, PI Our lab studies the biomechanics of motion in animals, conducting integrative research that crosses traditional boundaries of engineering and biology. Currently, two broad themes of our research center around gliding flight in vertebrates and internal fluid flows in invertebrates. We aim to understand animal movements both for fundamental understanding of animal physiology, ecology and evolution, and as inspiration for novel engineering applications. Bioinspired Science and Technology Group: Rolf Mueller, PI Dr. Mueller's research group seeks to develop solutions for sensing in complex natural environments, e.g., to enable drones that are capable of autonomous navigation in complex natural environments. To achieve this, the flight and biosonar behavior of bats is studied in Borneo with high-speed camera and ultrasonic microphone arrays. The insights from the work are then used in the design of biomimetic soft-robots and matching deep learning paradigms to replicate the bats' abilities. Division of Vehicle, Driver, and Safety Safety at the Virginia Tech Transportation Institute: Zachary Doerzaph, Director The Division for Vehicle, Driver,& System Safety applies cutting-edge scientific methods todesign, develop, refine, and evaluate solutions to complex transportation challenges;focusing on applications to improve the safety and effectiveness of transportation systems for the broad range of users.We support the development and evaluation of advanced technologies and operations using our laboratories, numerical models, test-tracks, field studies and analysis toolchains. The applied nature of our work is intended to support original equipment manufacturers, automotive suppliers, policy makers, and infrastructure owner operators in designing and improving the effectiveness of systems by quantifying performance benefits, resilience, unintended consequences, and potential misuse while also characterizing user acceptance, reliance, comprehension, and understanding of advanced vehicle and infrastructure systems. Division of Data and Analytics: Miguel Perez, PI Dr. Perez is interested in a variety of efforts that help to improve the safety and convenience of our transportation systems. He currently leads a number of efforts related to mitigation of temporary and permanent disability effects on driving, naturalistic driving study design and analysis, and data standardization, preparation, and mining. In addition, Dr. Perez is involved in efforts to improve the response of emergency vehicles to motor vehicle crashes. Complex Systems Laboratory: Nicole Abaid, PI The focus of the Complex Systems Laboratory is in the area of dynamical systems and control. Current research is largely focused collective behavior in multi-agent systems and spans agent-based modeling, studies of synchronization and consensus, field studies with wild animals, and bio-inspired robotic systems. Other research projects include studying the feasibility of auditory stimulation for closed-loop control of neural oscillations. Computational Biomechanics and Applied Mechanics (CBAM) Group: Costin D. Untaroiu, PI The Computational Biomechanics and Applied Mechanics (CBAM) Group conducts research on a large range of topics in applied mechanics, including injury biomechanics, human body modeling, vehicle safety, applied machine learning, and autonomous vehicles. This research is sponsored by industry consortiums (e.g. GHBMC), and government agencies (e.g. NHTSA, NASA). Damage Science and Mechanics Laboratory: John “Jack” Duke, Jr., PI In order to assure the safety and reliability of critical assets, it is critical to understand the science of how systems degrade and how this damage affects performance. The Damage Science and Mechanics Laboratory works within the multiple disciplines needed to achieve this goal. Sustainable system planning and design, life-extension, system prognostics, and system and structural health monitoring are areas where this work finds applications. The Dynamic Active Materials Laboratory: John Domann, PI The Dynamic Active Materials Laboratory investigates the coupling of solid mechanics and electrodynamics in active material systems, including piezoelectric, magnetoelastic, and composite multiferroic structures. This work covers everything from creating analytical and numerical models to measuring fundamental material properties and developing devices that exploit the coupled behavior of these systems. Future Materials Laboratory: Reza Mirzaeifar, PI In the Future Materials Laboratory, we are developing and utilizing a unique set of multiscale experimental and computational methods to study the mechanical behavior of a broad range of advanced materials, at the atomistic, micro, and macroscales. We fabricate novel metal-graphene composites at different length scales, 3D print alloys, and fabricate nano-sized polymer fibers and sheets. In each case, we perform cutting-edge experiments combined with multiscale computational studies to engineer the nano, and microstructure of the materials to obtain exceptional mechanical properties. Kevin P. Granata Biomechanics Lab: Robin Queen, PI The Kevin P. Granata Biomechanics lab, directed by Robin Queen, is dedicated to preventing injuries, determining optimal rehabilitation strategies, and assessing readiness to return to activity for those impacted by injury or joint pain. In the spirit of Ut Prosim (That I May Serve) we strive to positively impact the lives of individuals across the lifespan from young children to older adults by restoring movement and loading symmetry and preserving long-term joint health through mechanical and therapeutic interventions. Laboratory for Fluid Dynamics in Nature: Anne Staples, PI The research at the Laboratory for Fluid Dynamics in Nature (FINLAB) is focused on two main themes: fluid flows in nature and advanced computational methods for fluid flows. The natural systems studied in the FINLAB range from insect respiratory flows, which occur at the microscale, to human cardiovascular flows and other biomedically relevant flows, to planetary atmospheric flows with length scales on the order of tens of kilometers. There is an emphasis on bioinspiration, on high performance computing and advanced computational methods, including machine learning, on algorithms, and on experimental validation, including microfluidics experiments. Laboratory of Transport Phenomena for Advanced Technologies: Rui Qiao, PI In this laboratory, we explore the fundamental physics of transport phenomena with an emphasis on problems in which molecular and mesoscopic physics plays a key role. Our research is driven by challenges emerging at the frontiers of advanced technologies such as hydrocarbon extraction from unconventional sources, thermal management, and engine reliability in aggressive environments. We focus on atomistic, mesoscopic, and continuum modeling, but we also work closely with experimentalists and theoreticians. Recent research interests include nanofluidic transport in unconventional reservoirs, particulate manipulation in low-Reynolds number flows, particulate transport in aero-engines, and thermal and fluid transport in thermal management systems. Materials Response Group: Scott Case and David Dillard, PIs The Materials Response Group (MRG) is a research group within the Engineering Science & Mechanics Department at Virginia Tech focusing on the response of material systems to mechanical and environmental loading. Of particular interest are polymer and ceramic composites, adhesives, and scientific visualization. Multiphysics Intelligent and Dynamical Systems Lab: Shima Shahab, PI Multiphysics Intelligent and Dynamical Systems (MInDS) laboratory focuses on the intersection of smart materials and dynamical systems for various interdisciplinary applications such as energy harvesting, biomimetic locomotion and contactless acoustic energy transfer; biomedical opportunities and challenges. Current research topics at MInDS include intelligent fluid flow control using smart materials and metamaterial-inspired concepts, high-intensity focused ultrasound for wireless charging of low-power sensors, and ultrasound responsive drug delivery systems. The goal is to design new generation of smart autonomous biomedical systems which leads to new medical diagnostics and treatments. Musculoskeletal Biomechanics Group: Jennifer S. Wayne, PI The Musculoskeletal Biomechanics group conducts research on a range of topics in biomechanics, particularly of the musculoskeletal system but also of biological tissues in general. Experimental analyses and computational simulations of function in normal, injured, and repaired states; CT image and morphometric analysis. Nature-Inspired Fluids & Interfaces Lab: Jonathan Boreyko, PI Inspired by nature's design for animals, plants, and the weather, our group's research involves characterizing unexplored phenomena and designing innovative materials and systems. Our research is a multi-disciplinary combination of fluids dynamics, heat transfer, interfacial phenomena, materials science, and renewable energy. Nonlinear Systems Laboratory: Craig Woolsey, PI The Nonlinear System Laboratory (NSL) in the Aerospace and Ocean Engineering Department at Virginia Tech provides a facility for research and instruction in dynamics and control of nonlinear systems, with particular focus on autonomous ocean and atmospheric vehicles. Founded in 2005, the NSL is co-directed by Dr. Cornel Sultan, Dr. Mazen Farhood, and Dr. Craig Woolsey. The Lab supports Virginia Tech's Autonomy and Robotics group. Orthopedic Mechanobiology Lab: Vincent M. Wang, PI (@vwang_VT) The Orthopedic Mechanobiology Lab conducts research on orthopedic and soft tissue biomechanics, mechano-stimulation of tendon healing, and artificial intelligence approaches to injury detection. Our collaborative, interdisciplinary approaches include (a) pre-clinical animal studies and experimental assessment of tendon biomechanics, structure, and cell biologic responses, (b) machine learning analyses of clinical ultrasound images, (c) structure-function investigations of soft tissue pathomechanics, and (d) biomechanical studies of soft tissue surgical repair procedures. Ross Dynamics Lab: Shane Ross, PI The Ross Dynamics Lab performs mathematical modeling and experiments of nonlinear dynamics with applications to patterns of dispersal in oceanic and atmospheric flows, passive and active aerodynamic gliding, dynamic buckling of flexible structures, ship dynamics, orbital mechanics, and control of escaping dynamics. The

STRETCH Lab: Raffaella De Vita, PI Research in the STRETCH Lab focuses on characterizing the mechanical properties of biological systems ranging from cellular components to tissues, with special emphasis on the development of new mathematical models and experimental methods. Although our research interests are diverse and continuously evolve over time, the common thread that runs through much of our work is our genuine passion in advancing fundamental and mechanistic knowledge of biological systems. This knowledge is crucial for the development of effective interventions to prevent and treat illness and disability. Theoretical and Applied Fluid Mechanics Group: Mark Stremler, PI The Theoretical and Applied Fluid Mechanics (TAFM) Group conducts research on a range of topics in fluid mechanics, including reduced-order mathematical, numerical, and experimental models of fluid flows, with an emphasis on fluid-structure interaction, flows dominated by coherent vortical structures, microfluidic systems, fluid dynamics in biological systems, and connections to dynamical systems theory, particularly applications to fluid mixing. VibRo Lab: Oumar Barry, PI The VibRo Lab Group conducts fundamental research at the interface of nonlinear vibrations and robotics focusing on energy harvesting, vibration control, and structural health monitoring. The goal is to create novel analysis, design, and control techniques for the discovery of emerging technologies with applications in smart grid, healthcare, advanced manufacturing, and autonomous systems. Research at the VibRo Lab is divided into four thrust areas as follows: (1) mobile robots for vibration control and inspection of civil infrastructure, (2) human vibrations and assistive robotics, (3) adaptable metamaterials and metastructures, and (4) accuracy and precision in advanced manufacturing.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

MS thesis option Students pursuing the MS thesis degree option must complete at least 30 credit hours, including at least 21 graded course credit hours and satisfactorily prepare and defend a master's thesis. The final transcript will designate the degree as thesis. The MS thesis option must satisfy the following requirements: ESM 5014 Introduction to Continuum Mechanics (3 credits) One ESM 5xxx/6xxx course in two of the following three areas: dynamics, solid mechanics, or fluid mechanics (3 credits in each area, for a total of 6 credits) One course satisfying the mathematics requirement (3 credits) Graded elective courses (at least 9 credits) ESM 5994 Research and Thesis (at least 6 credits) MS students must also pass at least two credit hours of 5944 Seminar during two separate semesters. These seminar credits are not included on the Plan of Study. The MS Plan of Study may contain a combination of 5xxx and 6xxx-level courses and a maximum of six (6) hours of approved 4xxx-level courses. A minimum of 12 course credits must be labeled ESM (not including 5944 or 5994). A maximum of six (6) credit hours of independent study (IS) or special study (SS) courses can be used to complete the Plan of Study, with the total for both IS and SS courses not exceeding six (6) hours. MS non-thesis option Students pursuing the MS non thesis degree option must complete at least 30 graded course credit hours and satisfactorily pass a comprehensive oral examination. The final transcript will designate the degree as non thesis. The MS non-thesis option Plan of Study must include at least 30 credit hours that satisfy the following requirements: ESM 5014 Introduction to Continuum Mechanics (3 credits) Two ESM 5xxx/6xxx courses in two of the following areas: dynamics, solid mechanics, or fluid mechanics (3 credits in each area, for a total of 6 credits) One course satisfying the mathematics requirement (3 credits) Graded elective courses (at least 18 credits) MS students must also pass at least two credit hours of 5944 Seminar during two separate semesters. These seminar credits are not included on the Plan of Study. The MS Plan of Study may contain a combination of 5xxx and 6xxx-level courses and a maximum of six (6) hours of approved 4xxx-level courses. A minimum of 12 course credits must be labeled ESM (not including 5944 or 5994). A maximum of six (6) credit hours of independent study (IS) or special study (SS) courses can be used to complete the Plan of Study, with the total for both IS and SS courses not exceeding six (6) hours.

MEng Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

Master of Engineering (MEng) This program is oriented toward engineering practice instead of fundamental research, teaching or further study. This degree is intended to increase the competence of students who are interested in design, development, operation, and engineering practice. Students pursuing the MEng degree option must complete at least 30 credit hours and satisfactorily prepare and defend an engineering project report. The purpose of the project report is to develop and demonstrate the candidate's ability to plan and execute projects relating to the practice of engineering. The MEng option Plan of Study must include at least 30 credit hours that satisfy the following requirements: ESM 5014 Introduction to Continuum Mechanics (3 credits) Two ESM 5xxx/6xxx courses in two of the following areas: dynamics, solid mechanics, or fluid mechanics (3 credits in each area, for a total of 6 credits) One course satisfying the mathematics requirement (3 credits) Graded elective courses (at least 15 credits) ESM 5904 Project and Report (3 credits) MEng students must also pass at least two credit hours of 5944 Seminar during two separate semesters. These seminar credits are not included on the Plan of Study. The MEng Plan of Study may contain a combination of 5xxx and 6xxx-level courses and a maximum of six (6) hours of approved 4xxx-level courses. A minimum of 12 course credits must be labeled ESM (not including 5944 or 5994). A maximum of six (6) credit hours of independent study (IS) or special study (SS) courses can be used to complete the Plan of Study, with the total for both IS and SS courses not exceeding six (6) hours.

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

Students must earn a minimum of 90 credit hours beyond the bachelor's degree. A Master's degree is not required for admission the program. Core Courses ESM 5014: Intro to Continuum Mechanics (3 credits) ESM 5314: Intermediate Dynamics (3 credits) ESM 5024: Intro to Solid Mechanics (3 credits) ESM 5054: Intro to Fluid Mechanics (3 credits) ESM 5004: Scientific Communication in Engineering Mechanics (2 credits) Math Courses MATH 5000-6000 level courses (3 credits). See EM Graduate Regulations manual for approved Math courses. ESM Courses Additional ESM coursework, ESM 5000-6000 level courses (6 credits). See EM Graduate Regulations manual for approved courses. Additional Coursework 5000-6000 level courses that support area of doctoral research (12 hours) Seminar ESM 5944 (Minimum of 4, one-credit hour seminars) (4 credits) Program-specific credits from above: 39 hours Additional Coursework Agreed upon by student and advisory committee: 21 hours Dissertation Research ESM 7994 (Research/Thesis) (30 hours) Minimum Total Credits: 90 PhD students must also pass at least four credit hours of 5944 Seminar during four separate semesters. These seminar credits are not included on the Plan of Study. The PhD Plan of Study may contain a combination of 5xxx and 6xxx-level courses and a maximum of six (6) hours of approved 4xxx-level courses. A minimum of 20 course credits must be labeled ESM (not including 5944 or 5994). A maximum of three (3) credit hours of independent study (IS) can be used to complete the Plan of Study.

GRADUATE COURSES (ESM)

ESM 5004:

Scientific Communication in Engineering Mechanics

Strategies and techniques for effective scholarly and professional communication. Preparation for writing journal and conference papers, developing grant proposals. Critical analysis of the presentation of research articles and grant proposals. Designing and presenting conference talks and posters. Seminar presentations. Informal communication. Ethics in communication. Pre: Graduate Standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5014:

Introduction to Continuum Mechanics

Analysis of stress and deformation at a point. Development of the basic equations of a continuous medium by applying the basic laws of conservation of mass, linear momentum, moment of momentum and those of thermodynamics. Study of constitutive axioms and constitutive relations for fluids and solids. Specialization of the field equations to simple boundary-value problems of solid mechanics and fluid mechanics with simple solutions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 3015

Corequisite(s):

ESM 5024:

Intro to Solid Mechanics

Review of fundamental solid mechanics concepts including strain, stress. Nonlinear and linear elasticity, yield, elastic-plastic problems, flow plasticity, flow instabilities, viscoelasticity, viscoplasticity, creep, and fracture.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5044G (CEE 5610):

Advanced Mechanics of Composite Materials

Introduction to the deformation, stress, and strength analysis of continuous-fiber-polymer-matrix laminated composites. Fabrication, micromechanics of stiffness and expansional coefficients, classical lamination theory. Environmentally induced stresses. Computerized implementation and design. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5054:

Introduction to Fluid Mechanics

Fundamentals of fluid mechanics, including approximations, flow regimes, boundary conditions, vorticity, Bernoulli equations, boundary layers, lift, separation and drag, introduction to turbulence, waves in fluids.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014

Corequisite(s):

ESM 5064 (AOE 5064):

Structural Optimization

Structural optimization via calculus of variations. Application of techniques of mathematical programming to optimize trusses, beams, frames, columns, and other structures. Sensitivity calculation of structural response. Approximation techniques and dual and optimality criteria methods. A background in optimization is necessary.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5114:

Topics in Composite Mechanics

In-depth study of a selected topic in analysis of composite materials, such as mechanics of composite strength and lifetime, mechanics of laminated composite structures, mechanics of discontinuous fiber composites. Includes 3D anisotropic constitutive behavior and stress analysis. May be repeated three times with different content for a maximum of 9 credits. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5044G

Corequisite(s):

ESM 5124:

Theory of Elasticity

Equations of equilibrium, strain-displacement, compatibility, and constitutive equations in terms of Airy and complex potential stress functions applied to plane engineering boundary value problems including beams, disks, thick-walled tubes, perforated plates, and various stress raiser problems. Three-dimensional applications to torsion, bending, semi-infinite solids. Galerkin vector, Papkovich functions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014, MATH 4426

Corequisite(s):

ESM 5134:

Advanced Mechanics of Materials

Thick-walled cylinders and spinning disks, introduction to thin plates and shells, beams on elastic foundations, energy methods, torsion of thin-walled members, unsymmetric bending, shear center, curved beams, beam-columns and ties, introduction to plastic collapse, introductory applied elasticity.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5144 (MSE 5144):

Deformation and Fracture of Materials

Deformation and fracture of engineering materials is considered in the context of solid mechanics and engineering methods for predicting strength and life. Topics include plasticity, failure criteria, fracture mechanics, crack growth, strain-based fatigue, and creep. Microstructure-property relationships are discussed. Laboratory demonstrations of behavior in mechanical tests are included. Partially duplicates material in ESM 4024 and both should not be taken.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 3054

Corequisite(s):

ESM 5174 (CHEM 5174):

Polymer Viscoelasticity

Constitutive models of linear viscoelastic materials, experimental aspects, polymer response to mechanical and electrical inputs, solid state NMR and microwave interactions with polymers, free volume theories, temperature and environmental effects on polymers, physical aging of glasses. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5224 (BMES 5124):

Advanced Musculoskeletal Biomechanics

Skeletal anatomy and mechanics. Muscle anatomy and mechanics. Theory and application of electromyography. Motion and force measuring equipment and techniques. Inverse dynamics modeling of the

human body. Current topics in musculoskeletal biomechanics research.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ESM 5245G:

Mechanics Animal Locomotion

The mechanical and biological principles of animal locomotion. Comparative examples from locomotor modes including walking, running, jumping, climbing, burrowing, and crawling used to extract general principles underlying kinematics, dynamics, energetics, and control. Terrestrial locomotion-based bio-inspired design.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ESM 5246G:

Mechanics Animal Locomotion

The mechanical and biological principles of animal locomotion. Locomotor modes including active and gliding flight, swimming, jetting, and running on water, examined from perspectives of kinematics, dynamics, energetics, and control. Engineering design inspired by fluids-based biological locomotion.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ESM 5264 (ME 5264):

Mechanics of Adhesive Bonding and Interfaces

Principles of mechanics applied to adhesively bonded joints and interfaces, overview of adhesion technology, stress analysis of adhesive joints, stresses in bimaterial systems and interfaces, failure mechanisms and fracture, thermodynamic and observed toughnesses, time dependence and durability, design.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ESM 5304 (AOE 5034):

Mechanical and Structural Vibrations

Free and forced vibration of single-degree-of-freedom systems, multi-degree-of-freedom systems, continuous systems including strings, rods, bars, and beams. Natural frequencies and modes. Rigid Body modes. Proportional and nonproportional damping. Response to harmonic, periodic, and nonperiodic excitations. Solutions by modal analysis, direct integration and Fourier Series. Approximate methods including assumed modes and the Rayleigh-Ritz method. Advanced topics chosen by instructor.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ESM 5305:

Biomechanics of the Cardiovascular System

5305: Mechanics of the heart, arterial blood vessels and microcirculation; history of the circulation; anatomy and physiology of the heart; mechanics of cardiac contraction; cardiac fluid mechanics; work, energy, efficiency of cardiac function. 5306: Rheology of blood; hematology; elasticity of blood vessel walls; transport processes; control of the circulation; mathematical analysis of pulsatile blood flow and pulse-wave propagation through small arteries, capillary beds and extra-corporeal devices.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ESM 5306:

Biomechanics of the Cardiovascular System

5305: Mechanics of the heart, arterial blood vessels and microcirculation; history of the circulation; anatomy and physiology of the heart; mechanics of cardiac contraction; cardiac fluid mechanics; work, energy, efficiency of cardiac function. 5306: Rheology of blood; hematology; elasticity of blood vessel walls; transport processes; control of the circulation; mathematical analysis of pulsatile blood flow and pulse-wave propagation through small arteries, capillary beds and extra-corporeal devices.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 4106

Corequisite(s):

ESM 5314:

Intermediate Dynamics

Review of Newtonian mechanics, fundamental concepts of analytical mechanics, Hamiltons principle, Lagranges equations, rigid-body dynamics, Eulers equations, gyroscopic principles, definitions of stability, geometric theory (phase-plane trajectories), limit cycles, state-space analysis, Routh-Hurwitz criterion, Liapunov direct method.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5334:

Interfacial Fluid Mechanics

Interfacial fluid systems involving surface tension, interfacial hydrodynamics, and phase-change heat transfer. Scaling analysis and non-dimensionalization will be used to mode a variety of interfacial phenomena relevant to fluid mechanics and phase-change heat transfer. Capillarity, surface wettability, hydrodynamics of interfaces, flow instabilities, long range forces, convective and diffusive boundary layers, homogeneous and heterogeneous nucleation, and multiphase flows.

Pre: Graduating standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5344:

Wave Propagation in Solids

Formulation and solution of propagation problems in infinite, isotropic media. Solution of the reflection-refraction problem at plane interfaces. Discussion of Rayleigh, Love, and general surface waves. General treatment of wave propagation in infinite anisotropic media. Wave diffraction phenomena. Waves in bounded media: bars and plates.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014

Corequisite(s):

ESM 5405:

Clinical Internship in Biomedical Engineering

Off-campus student exposure and participation in a planned clinical experience for those preparing to enter the field of Biomedical Engineering. On-campus lecture/lab/demonstration sessions to supplement the clinical experience. Students are placed in selected hospitals throughout the local area during two summer sessions under close supervision of a university staff member and cooperating medical personnel.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5406:

Clinical Internship in Biomedical Engineering

Off-campus student exposure and participation in a planned clinical experience for those preparing to enter the field of Biomedical Engineering. On-campus lecture/lab/demonstration sessions to supplement the clinical experience. Students are placed in selected hospitals throughout the local area during two summer sessions under close supervision of a university staff member and cooperating medical personnel.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5414:

Nonlinear Systems

Dynamics of conservative and nonconservative systems; phase planes; local and global stability; damping mechanisms; self-excited oscillators. Forced oscillations of one-degree-of-freedom systems; primary, secondary, and multiple resonances; period-multiplying bifurcations; strange attractors; chaos. Parametric excitations; Floquet theory; influence of damping and nonlinearity. Multi-degree-of-freedom systems; concepts of internal and external resonances; Hopf bifurcation. Applications to continuous systems; strings, beams, plates, and shells.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5754, ESM 5304

Corequisite(s):

ESM 5454 (AOE 5054):

Elastic Stability

Stability of elastic structural components under conservative loads; precise definitions of stability; energy approaches; Rayleigh-Ritz and Galerkin methods; and applications to column, arches, plates, and shells.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 3404 OR AOE 3124

Corequisite(s):

ESM 5504:

Introduction to Ideal Flow

Kelvin-Helmholtz theory of vorticity. Velocity potential. Stream function. Complex potential and conformal mapping. Introduction to two-dimensional panel methods. Thin-airfoil theory. Steady and unsteady lifting flows.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5514:

Viscous Flow

Governing equations of viscous heat-conducting gases. Exact solutions to the Navier-Stokes equations. Low- Reynolds-number flows. Incompressible and compressible boundary layers. Finite-difference methods for boundary layers. Flow separation and strong viscid-inviscid interactions: interacting boundary layers and triple deck theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014

Corequisite(s):

ESM 5524:

Compressible Flow I

Introduction to fundamentals of compressible fluid flow. Linearized theory, unsteady flows, steady flows, shock waves, wave interactions, method of characteristics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014

Corequisite(s):

ESM 5554 (CEE 5130):

Turbulence and Turbulent Flows

Nature and origin of turbulence, turbulent transport of momentum and heat, the dynamics of turbulence, statistical description of turbulence and spectral analysis. Examples of turbulent flows, boundary layers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5734:

Introduction to the Finite Element Method

Formulation and computer implementation of finite element models of typical equations of fluid flow, heat transfer, and solid mechanics. The problems considered include heat conduction and convection, torsion, ground water flow, electrostatics and magnetism, plane elasticity, flow of viscous incompressible fluids, and plate bending. Both theoretical development and computer program development are studied. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5744:

Energy and Variational Methods in Applied Mechanics

Variational calculus, energy principles of solid mechanics, and variational methods of approximation applied to engineering problems. Derivation of equations of mechanics from energy and variational principles (i.e. virtual work principles). Formulation and solution of initial-, boundary- and eigen-value problems of engineering by direct variational methods, such as the Ritz, Galerkin, least-squares, and collocation methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MATH 4425

Corequisite(s):

ESM 5754 (MATH 5754):

Introduction to Perturbation Methods

Asymptotic expansions and series, approximate solutions of algebraic equations, straightforward expansions and their regions of nonuniformities, the Lindstedt-Poincare technique, the method of renormalization, the method of averaging, the method of matched asymptotic expansions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MATH 2214 OR MATH 2514 OR MATH 4544

Corequisite(s):

ESM 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ESM 5944:

Seminar

Discussion of current research topics in Mechanics by local and visiting scholars. May be repeated with different content for a maximum of 4 credits. Pass/Fail only. Pre: Graduate Standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ESM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ESM 6024:

Mechanics of Soft Tissues

Stress and strain tensors for large deformations, Conservation laws, Thermodynamics principles, Material symmetry, Hyperelastic materials, Chemoelasticity, Electroelasticity, Viscoelasticity, Initial and boundary conditions, Review of analytical and numerical methods for solving large deformation problems, Solutions of problems. Knowledge of Finite Element Methods at the undergraduate level is recommended.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014

Corequisite(s):

ESM 6044:

Theory of Plates and Shells

Reduction of 3-D elasticity to an equivalent 2-D counterpart. Basic assumptions. Field equations of the theory of plates and shells. Linear and nonlinear theories. Buckling and vibrations. Postbuckling. Refined plate and shell theories. Implications of non-classical effects on the static, dynamic and buckling behaviors.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014, (MATH 4425 OR MATH 4564)

Corequisite(s):

ESM 6054:

Fracture Mechanics

Linear elastic and elasto-plastic models of local stress fields around crack tips. Concepts of stress intensity strain energy release rate, strain energy density. Mathematical models for dynamic crack extension and fatigue crack growth. Correlation of mathematical models with fracture toughness testing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5014

Corequisite(s):

ESM 6164 (BMES 6164):

Computational Modeling in Impact Biomechanics

Dynamic modeling of the human body subjected to transient impact loading. A combination of finite element analysis and multi-body simulated techniques. Utilized software packages with dynamic solvers. Applications include computer-aided design for automobile safety, sports biomechanics, and military restraint systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (BMES 5164 OR ME 5754) OR (ESM 5014, ESM 5314)

Corequisite(s):

ESM 6254 (AOE 6254):

Turbulence Modeling and Simulation

In-depth study into the modeling and simulation of turbulent flows. Derivation of exact equations describing turbulent flows along with various approaches to turbulent closure. Turbulence modeling via algebraic, RANS, and Reynolds stress models. Turbulence simulation via DNS, LES and hybrid RANS/LES approaches and analysis of results. Turbulence compressibility effects, body forces, boundary conditions, wall functions, sub-grid modeling approaches, turbulence anisotropy and stress invariants, and realizability. Strengths and weaknesses of the different modeling and simulation approaches. Role of numerics in different modeling approaches. Pre: Graduating standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 6314 (AOE 6314):

Advanced Dynamics

Fundamental concepts of analytical mechanics, variational principles, Lagranges equations, rigid-body kinematics and dynamics, Euler parameters, quasi-coordinates, Eulers equations, gyroscopic systems, Hamilton-Jacobi equation, transformation theory, introduction to optimal control theory, advanced concepts in stability theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5314

Corequisite(s):

ESM 6514:

Computational Methods for Viscous Flows

Navier-Stokes equations in curvilinear systems. Thin-layer and parabolized Navier-Stokes equations. Stability analysis of finite-difference methods applied to model equations. Methods for grid generation. Finite-difference methods for compressible and incompressible Navier-Stokes equations. Spectral methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5514

Corequisite(s):

ESM 6714:

Applied Tensor Analysis

Basis vectors, Christoffel symbols, metric tensor. Covarient, contravarient vectors and tensors. Covarient differentiation. Orthonormal systems and physical components of tensors. Surface tensors, curvature tensors, principal curvatures, geodesics and asymptotic lines. The basic ideas will be illustrated by and applied to problems in continuum mechanics, solid and fluid mechanics, rigid body dynamics, and electromagnetic theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MATH 4574

Corequisite(s):

ESM 6734:

Finite Element Analysis

Alternative finite element models; three-dimensional problems; eigenvalue problems; nonlinear formulations for fluid flow and plate bending; and mathematical properties of finite-element approximations; direct and Newton-Raphson iterative methods for the solution of nonlinear equations; computer implementation of nonlinear finite-element models.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 4734 OR ESM 5734

Corequisite(s):

ESM 6974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ESM 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ESM 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENGLISH

Kelly Pender, Chair
Gena Chandler-Smith, Associate Chair

Professors: Charlene Eska; Joseph Eska; Kenneth Hodges; Derek Mueller; Su Fang Ng; Kelly Pender; Katrina Powell; David Radcliffe; Rebecca Weaver-Hightower;

Associate Professors: Katie Carmichael; Gena Chandler-Smith; Katharine Cleland; Anthony Colaianne; James Dubinsky; Shoshana Knapp; Ashley Reed; Andrew Wadoski; Abby Walker;

Assistant Professors: Sweta Baniya; Silas Cassinelli; Carolyn Commer; Julie Gerdes; Cana Itchuaqiyaq; Chris Lindgren; Geovani Ramirez; Tyechia Thompson; Travis Webster; Avery Wiscomb;

Visiting Faculty: Emily Waldman;

Clifford A. Cutchins III Professor of English: Su Fang Ng;

Assistant Professor of Practice: Megan Weaver;

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Graduate Site: https://liberalarts.vt.edu/departments-and-schools/department-of-english/academic-programs/master-of-arts-in-english.html

The Master of Arts Program in English at Virginia Tech is a general master's degree in the study of literature and language. Students explore their own interests in British and American literature through a variety of courses. Some classes are shared with the Masters of Fine Arts students in our Creative Writing program. Some classes are shared with doctoral students in our Rhetoric and Writing program. Students will develop core competencies in British, American, and World Literatures the analysis of texts the writing and development of arguments defining a problem and/or creating a research question the processes of academic research The interdisciplinary nature of English studies enables students to also take classes in other programs such Women's and Gender Studies, Science & Technology Studies, Africana Studies, and History. This cross-disciplinary focus provides students with exposure to various dimensions of English studies. Students then apply that exposure and pursue independent research either as a thesis or capstone project. Students work in a close relationship with our award-winning faculty to develop their thesis or capstone projects toward their unique career and academic goals. Since our program builds core competencies in critical reading, writing, research, and analysis that can be applied in a variety of ways beyond the MA degree, our graduates typically move into a variety of fields including business, law, technology, marketing, design, teaching, and technical writing. More recently, our students move in one of three directions upon completion of their degree: enrollment in a PhD program in literature or writing; high school- or instructor-level teaching; writing or document-related jobs in technical writing. The interdisciplinary nature of English studies allows students to strengthen these core English competencies while developing and shaping a curriculum that speaks to students' individual interests and career goals. Applicants who are interested in our assistantships should apply no later than Friday, February 3, 2023. For more information about our Master of Arts degree in English, please consult our website: https://liberalarts.vt.edu/departments-and-schools/department-of-english/academic-programs/master-of-arts-in-english.html.

SPECIAL FACILITIES

The 360 Digital Studio at Virginia Tech

The 360 Digital Studio at Virginia Tech is located on the second floor of the English Department (Shanks Hall 360). Students enrolled in any English classes at Virginia Tech may use the 360 Digital Studio to Print Assignments for Classes Work on group projects using any one of the 6 large tv screens and other resources Access professional software (40+) with various design, word processing, and data analysis capabilities For more information about The 360 Digital Studio, consult the following link: https://360digitalstudio.github.io/about_us.html

The Center for Rhetoric in Society

The Center for Rhetoric in Society is located on the third floor of the English Department (Shanks Hall 340 E) on the Virginia Tech campus in Blacksburg, Virginia. The Center was formed in 2006 in the Department of English. With a mission to investigate language use through rhetorical and narrative analysis to understand significant social problems, the Center serves as an incubator for individual and collaborative research projects, events, and community outreach programs. We ask how language inspires people to action and how writing changes society and why. We search for answers by studying everything from the communication strategies of national social change movements to everyday rhetorics that often go unnoticed and unexamined. We share our findings at conferences and in publications and through outreach programs and other events. The CRS is an affiliated center with the Institute for Society, Culture, and Environment and various projects have received seed funding from ISCE.Learn more about opportunities to get involved with the center and contact us if you’d like more information at rhetoric@vt.edu or consult our website at https://www.rhetoric.english.vt.edu/.

The Linguistics Speech Lab

The Linguistics Speech Lab is housed on the second floor of the English Department (Shanks Hall 254). The Speech Lab is A venue for meetings A place to process linguistic data A place to collect linguistic data (through interviews or experiments) The home of linguistic corpora The home of useful equipment and a mini-library The Lab is available to faculty, undergraduate, and graduate researchers. For more info, please contact Abby Walker at ajwalker@vt.edu or Katie Carmichael at katcarm@vt.edu or consult our website at http://www.vtlinguistics.com/speech-lab/.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Computer: (233.0)

iBT: (90.0)

The MA in English requires 36 hours of coursework. All students must take two required courses in Literary Research (ENGL 5014) and Critical Theory (ENGL 5024). Students who are funded as a teaching assistant in the composition classroom must also take a course on the theory and practice of university writing instruction (ENGL 5004). The final requirement is the completion of a "Capstone" project. The Capstone Project has a thesis (6 credits) and a non-thesis (3 credits) option. Because work in literature and language frequently is interdisciplinary, students are permitted to take six of their credits outside of the department. Students may also work toward a graduate certificate offered by the Virginia Tech Graduate School in a related field. Possible fields include Africana Studies, Future Professoriate, Material Culture and Pubic Humanities, Public History, Race and Social Policy, Religious Studies, Science and Technology Studies, and Women and Gender Studies. https://liberalarts.vt.edu/departments-and-schools/department-of-english/academic-programs/master-of-arts-in-english.htmlTESTING REQUIREMENTS*The GRE general and subject test are NOT REQUIRED for admission to the Virginia Tech M.A. Program in English.**For International Students*International students seeking admission must receive a minimum TOEFL score of 90 or an IELTS score of 6.5 for admission. Students must also receive a TOEFL score of 20 or higher in the Listening, Writing, Speaking, and Reading subsections. In addition to these tests, English proficiency can also be demonstrated through a conferred bachelor's degree from an accredited university where English is the medium of instruction. In this instance, the Graduate School will code a waiver of the English proficiency requirement into the student's application. Students can confirm degree conferral and English as the medium of instruction by submitting their official transcripts with the application. For more information about policies and the application process for international students, consult the following links: https://graduateschool.vt.edu/admissions/how-to-apply/testing-requirements.html https://international.vt.edu/ Direct additional inquiries to Ms. Marie Trimmer, Graduate Programs Coordinator, mtrimmer@vt.edu or 540-231-4659.

GRADUATE COURSES (ENGL)

ENGL 5004:

Theory & Practice in University Writing Instruction

The study of rhetorical theory, related issues in writing pedagogy, and the practice of teaching composition at the university level for GTAs in the Department of English. Pre: Graduate Standing and appointment as a GTA in the Department of English.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5014:

Introduction to Literary Research

This course introduces the materials and methods of research used in English studies. Students learn how to locate primary texts, contextual documents, and critical scholarship, to evaluate their kinds and degrees of authority, and to incorporate and cite this material in original research. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5024:

Critical Theory in English Studies

Introduces graduate students to principal issues, concepts, terms, and methods currently employed in literary criticism and the interdisciplinary study of culture. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5034:

Practicum

Practical training in teaching composition at the university level. Required of all Graduate Teaching Assistants in English. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5054:

Composition Theory

Study of history and theory of teaching composition at the university-level. Introduction to research methods in Composition Studies. Detailed consideration of the epistemological and cultural implications of writing instruction. Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5064:

Topics in Language

Rotating topics in language study, exploring various theories of language and their bearing on literary interpretation, rhetoric, and textual criticism. Content will vary; may be repeated once for credit. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5074:

Introduction to Digital Humanities

This course introduces students to the history and critical theory necessary to understand the broad import of digital technology for English Studies and to the knowledge and skills required to critique and produce digital documents. Must have graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5084:

Creative Writing Practicum

Training in teaching introductory creative writing at the university level. Emphasis is on the theory and practice of teaching creative writing, preparing materials and class sessions, and responding to student writing. Pre-requisite: Graduate Standing in the MFA program in the Department of English and appointment as a GTA.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5094:

Collab Research Practicum

Practical training in collaborative research practices in discourse analysis, ethnography, historical investigation and other subjects at the graduate level. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5114:

Studies in Medieval Literature

Rotating studies in medieval literature, focusing on particular themes, genres, works, or figures within their historical, social and literary context. Content will vary; may be repeated for credit. Pre: Graduate Standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5124:

Studies in Renaissance Literature

Rotating studies in British literature from 1500 to 1660, focusing on literary traditions, themes, or representative writers. May be repeated once for credit. Pre: Graduate Standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5164:

Studies in Black American Literature

Rotating studies in Black American literature, focusing on its roots in folk and oral traditions; on key periods, such as the Harlem Renaissance; or on themes, genres, or selected figures. Content will vary; may be repeated once for credit. Pre: Graduate Standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5214:

Topics in Race and Pre-Modern Literature

Pre-modern ideas of race and how they appear in literature, from heathen Saxons to Saracen knights, from Jerusalem to the lands of Prester John. Connections and disparities between modern racial discourses and historical ones. Theories of race, descriptions of the world and its peoples, narratives of travel, and representations of race in literature. May be repeated one time with different content for a maximum of 6 credits. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5234:

Studies in Later English Authors

Rotating studies in the works of one or two later English writers, such as Dickens, Hardy, Tennyson, Woolf, Joyce, Yeats, and others. Contents will vary; may be repeated once for credit. Pre: Graduate Standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5244:

Studies in American Authors

Rotating studies which offer intensive treatment of one or two American authors, with particular attention to historical, biographical, cultural, and/or critical and theoretical contexts. Content will vary; may be repeated once for credit. Pre: Graduate Standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

ENGL 5314:

Genre Studies

Rotating studies of particular genres--lyric, biography, literary criticism, speculative fiction--in relation to their social, intellectual, and literary contexts. Content will vary; may be repeated once for credit. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5334:

Special Topics in Literature

Approaches to the study of literature that cross the boundaries of genre, period, and nationality, exploring innovative combinations of texts, critical methods, and interpretive approaches. Contents will vary; may be repeated once for credit. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5354:

Comparative Studies in Literature

Rotating studies in global literature and theory, focusing on comparisons of authors, works, periods, or genres of different regions, countries, and/or cultures. Content will vary; may be repeated once for credit. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5454:

Studies in Theory

Rotating studies of the major issues, figures, and movements in literary and critical theory. Content will vary; may be repeated once for credit. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5464:

Introduction to Medical Humanities

Introduction to the medical humanities. Literary inquiry as narrative medicine, medicine and literature, literary bioethics, medical rhetoric, and cultural studies of medicine.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5474:

Teaching Literature

Practices of teaching literature at the college and university level, including close reading, the application of critical theory, the introduction of historical and social contexts, and the making and assessing of writing assignments. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5514:

American Literature of the Later Nineteenth Century

American literature from the Civil War to the end of the century, with emphasis on Whitman, Dickinson, Twain, James, and Crane. Pre Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5534:

Studies in Literary History

Rotating studies in literary history. Topics, periods, and approaches will vary; may be repeated once for credit. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5554:

Topics in Race, Empire, & Postcoloniality

Ideas and discourses of race and ethnicity, empire, and postcoloniality in literature and culture. Theories of race and postcoloniality in critical reading of imperial projects and texts as well as postcolonial, Anglophone, and world literatures. Variable topics. May be repeated one time with different content for a maximum of 6 credits. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5614:

Visual Rhetoric and Document Design

Examination of the theories, research, and practices of visual rhetoric and document design. Emphasis on ways in which images and other visual methods of communication influence audiences. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5624:

Cultural Rhetorics

Cultural rhetorics theories, methodologies, and pedagogies. Study of the relationship between culture and rhetoric within local and global contexts. Focus on the processes by which language, texts, and other discursive practices like performance, embodiment, and materiality create meaning within various cultural contexts. Issues of power, privilege, and equity in rhetoric and writing studies. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5664:

Theory & Research in Tech Comm

Key theories, methods, strategies, genres, and modes of written and multimedia technical communication and information design. Intellectual history of the field and its relation to contributing disciplines. Economic, political, cultural, and ethical contexts of technical communication. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5674:

Rhetoric of Science, Technology, and Medicine

Analysis of the historical and philosophical development of the field of rhetoric of science, technology, and medicine through benchmark publications; examination of scientific and medical texts and technologies as objects of rhetorical criticism. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5724:

Form and Theory of Creative Nonfiction

Investigation of the history and conventions that have shaped the writing of creative nonfiction. Analysis of the forms and theories which underlie the development of creative nonfiction. Critique of the theoretical assumptions which have been applied to the genre. Application of convention and narrative techniques to the creation of original work. Identification and analysis of relevant publication venues. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5734:

Form and Theory of Fiction

A graduate course for writers of fiction in which students are taught to analyze the forms and theories which underlie the development of the genre. Students will be asked to critique the theoretical assumptions which have been applied to the genre and study the history and conventions that have shaped the writing of fiction. They will be required to interrogate the forms and prevailing theories which have shaped major novelists and short story writers, and apply what they discover to the crafting of their own fiction. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5744:

Form and Theory of Poetry

A graduate course for practicing poets and writers in which students are taught to analyze the forms and theories which underlie the development of the genre. Students will be asked to critique the theoretical assumptions which have been applied to the genre and study the history and conventions that have shaped the writing of poetry. Students will analyze prosody; imitate metrical forms, such as the sonnet and the sestina; and adapt the techniques used by poetic masters. Students will study the works of a wide array of writers, from Chaucer to contemporary poets. They will be required to interrogate the forms and prevailing theories which have shaped the voices of poets through the ages. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5774:

Editing a Literary Journal

Introduction to the process of editing a literary journal. As editors for the MFA Programs online journal of poetry, fiction, and essays. Developing critical skills as the basis for editorial decisions. Understand the dominant literary aesthetics informing contemporary writing; accept or reject submissions; maintain correspondence with authors; and meet deadlines. May be taken up to three times for a maximum of 9 credits. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5894:

Final Examination

For non-thesis candidates who are required to register for their final examination and have completed their program of study. Not to be included in minimum 33 hours required for degree.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ENGL 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENGL 6314:

Ancient Rhetorics in Written Communication

Study of major figures and concepts in classical rhetoric, with emphasis on applications to written communication. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6324:

Modern Western Rhetoric

Study of major figures, key concepts, and evolution of modern Western rhetoric. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6334:

Rhetoric in Society

Study of the relationship of language and human action, with emphasis on how rhetoric reflects and shapes social practices and how literate activity operates in a complex society; emphasis on written communication. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6344:

Rhetoric in Digital Environments

Study of the uses of digital media in research, information development and sharing, and advocacy regarding public issues. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6364:

Research Design in Rhetoric and Writing

Theory and practice of evaluating, designing, and conducting empirical research projects in rhetoric and writing. Focus on critiquing studies, developing research questions, selecting methods, and designing projects. Introduction to appropriate statistical concepts and methods as well as qualitative and hybrid methodologies. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6374:

Field Methods of Research in Rhetoric and Writing

Examination of field methods and methodology in rhetoric and writing, including case studies, enthnographies, qualitative interviews, and field/participant observations. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6514:

Studies in Rhetoric

Studies in the history, topics, sites of practice, and major figures of rhetoric, with application to written communication and English Studies. May be repeated twice for a total of 9 hours credit when the topic varies. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6524:

Theories of Written Communication

Studies in theories applied to written communication. May be repeated twice for credit for a total of 9 hours when the topic varies. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6704:

Fiction Workshop

This advanced course in fiction writing provides those who wish to pursue careers in creative writing with the tools they need to develop as novelists and short story writers. Primary focus in on the writing and critiquing of original short stories and longer pieces of original fiction, while paying close attention to the work of established fiction writers who are acknowledged masters of their genres. This course may be repeated up to the maximum credit hours (15). Previous workshop experience is required. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6714:

Poetry Workshop

This advanced course in poetry writing provides those who wish to pursue careers in creative writing with the tools they need to develop as poets. Primary focus is on the writing and critiquing of original poems, while paying close attention to the work of established poets who are acknowledged masters of their genres. This course may be repeated up to the maximum credit hours (15). Previous workshop experience is required. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6724:

Playwriting Workshop

This advanced course in playwriting provides those who wish to pursue careers in creative writing with the tools they need to develop as playwrights. Primary focus is on the writing and critiquing of original plays, while paying close attention to the work of established dramatists who are acknowledged masters of their genres, and to the aspects of playwriting that relate to theatrical production. This course may be repeated up to the maximum credit hours (15). Previous workshop experience is required. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6734:

Creative Nonfiction Workshop

Advanced course in creative non-fiction writing providing those who wish to pursue careers in creative writing with the tools that they need to develop as essayists and memoirists. Primary focus is on the writing and critiquing of original creative nonfiction, while paying close attention to the work of established creative nonfiction writers who are acknowledged masters of their genres. Course may be taken up to six times for a maximum of 18 hours of credit. Previous workshop experience is required. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6744:

New Media Writing Workshop

Advanced course in New Media writing that provides students with the knowledge and skills required to develop in this area of creative writing. Primary focus is on the writing and critiquing of original New Media works. Course may be repeated for up to a total of 12 credits. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENGL 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENTOMOLOGY

Timothy Kring, Head

Emeriti Faculty: James Bergh; Carlyle Brewster; Richard Fell; Donald Mullins; Peter Schultz; Michael Weaver;

Professors: Timothy Kring; Thomas Kuhar; Dini Miller; Douglas Pfeiffer; Scott Salom; Igor Sharakhov;

Associate Professors: Albert Auguste; Warren Booth; Sally Entrekin; Aaron Gross; Paul Marek; Sally Paulson; Arash Rashed; Kevin Rice; Maria Sharakhova;

Assistant Professors: Margaret Couvillon; Alejandro Del Pozo-Valdivia; Gillian Eastwood; Roger Schuerch; Chin-Cheng Yang;

Collegiate Assistant Professors: James Wilson;

General Contact: kshelor@vt.edu

Graduate Site: https://www.ento.vt.edu/academic-programs/graduate.html

The Department of Entomology provides professional expertise concerning arthropods to the commonwealth, the nation, and the world. This includes teaching, training, and advising undergraduate and graduate students; conducting basic and applied research on arthropods and the pathogens they vector; providing information about management of arthropods and the usefulness of beneficial arthropods available to clientele and the public; developing management strategies to control arthropod pests in Virginia; fostering development of entomological expertise at the state, national and international levels. The department has three major focus areas that include: (1) Biomedical Research, with emphasis on insect genomics and urban/public health. This includes mosquito and tick biology and vector control as they affect urban and public health, and human and animal disease; (2) Natural/Agro Ecosystems Research, with emphasis on Integrated Pest Management/Biological Control of pest problems, and environmental monitoring and protection, and (3) Urban Entomology and Pesticide Safety Education.

SPECIAL FACILITIES

The Entomology Department is housed in Price Hall with additional on-campus laboratory facilities located in Agnew Hall, Latham Hall and the Fralin Life Sciences Institute. Insectary and green house facilities are located both at on-campus and off-campus sites. Other laboratory and research facilities include: Dodson Urban Pest Management Laboratory and facilities at Prices Fork (Apiculture, Pollination Ecology, Forest Entomology, and Quarantine Laboratories). In addition, students and faculty have access to research facilities located at Kentland Farm in Blacksburg and at our Agricultural Research and Experiment Stations located throughout the state.

Price Hall

The Entomology Department is housed in Price Hall with additional on-campus laboratory facilities located in Agnew Hall, Latham Hall and the Fralin Life Sciences Institute. Insectary and green house facilities are located both at on-campus and off-campus sites. Other laboratory and research facilities include: Dodson Urban Pest Management Laboratory and facilities at Prices Fork Research Center (Apiculture Laboratory, Pollination Ecology Laboratory, Forest Entomology Laborartory, and Quarantine Laboratory). In addition, students and faculty have access to research facilities located at Kentland Farm in Blacksburg and at our Agricultural Research and Experiment Stations located throughout the state.

DEGREES OFFERED

MSLFS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

The Entomology Department offers a Master's in Life Sciences degree with concentration in Entomology (thesis or non-thesis/online), or a Doctorate in Entomology. The graduate program offers training in basic and applied entomology through a combination of graduate courses, research programs, and teaching experience. Masters of Science In the Life Sciences Degree (MSLFS)MS students must take at least one course in each of three core areas:(1) Biochemistry/Molecular and Cell Biology (Biochemistry for Life Sciences, Insect Physiology or Insecticide Toxicology); (2) Statistics (Biometry, Statistics in Research, or approved substitute); and (3) Information Management (Research and Information Systems in the Life Sciences). For the thesis-based MS, 20 credit hours of course work and 10 credit hours of research are required. For a non-thesis MS, a minimum of 30 credit hours of course work must be completed for graduation. With successful completion of both course work and research (thesis) requirements, MS students will receive a Masters of Science in the Life Sciences (MSLFS) with a Concentration in Entomology.Students in the Non-Thesis MSLFS Program are required to complete an internship and a project in addition to course work. The Non-Thesis MS student will complete the course requirements outlined in the Graduate Policies and Procedures and Course Catalog and those described above for MSLFS candidates in this department. They will have a Major Professor and Advisory Committee similar to those of other MSLFS candidates. The Advisory Committee will supervise the Plan of Study, the selection and conduct of the internship and project, and will conduct a Final Oral Examination. Note that a Non-Thesis Masters Degree is intended to be a terminal degree and is not a satisfactory prerequisite for continuing on toward a PhD. The department also participates in the college Online Master of Agricultural and Life Sciences degree program

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

Successful completion of a thesis-based MS in entomology or related field, OR significant experience in research as an undergraduate or in the workplace is required for admission to the PhD program. PhD students must take or have taken at least one course in each of three core areas: (1) Biochemistry/Molecular and Cell Biology (Biochemistry for Life Sciences, Insect Physiology or Insecticide Toxicology); (2) Statistics (Biometry, Statistics in Research, or approved substitute); and (3) Information Management (Research and Information Systems in the Life Sciences). PhD students are expected to demonstrate competency in their area of specialization and are required to take a minimum of 24 hours of courses numbered 5000 or higher. Candidates for the PhD must demonstrate breadth of experience in at least one topic apart from the major area of study. This enrichment experience must be approved by the Advisory Committee and may take the form of foreign language, business, computer science or other pre-approved topic or concentration of courses in a selective area.

GRADUATE COURSES (ENT)

ENT 5004:

Graduate Seminar

Lectures and discussions by faculty and students on a current topic pertinent to research being conducted in the department. Critical evaluation of principles, theories, and methods will be emphasized. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENT 5024:

Understanding Urban and Structural Entomology

Insects and arthropods pests that invade homes and other structures. Pest biology and behaviors that cause damage to buildings, businesses, and to human physical and mental health. Pest management practices based on assessment and utilization of all effective control practices where pest elimination is the intended outcome. Food Quality Protection Act, US HUD Housing bid requirements, the US EPA pesticide registration process, the Warranty of Habitability and social service policies which have contributed to underserved and elderly residents being the most at risk for large populations of urban pests. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENT 5114:

Insect Structure and Function

A comparative study of the major structures and organ systems emphasizing modifications important in the success of insects. Designed for graduate and upper level undergraduate students in entomology and zoological biology.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): ENT 3014

Corequisite(s):

ENT 5214:

Arthropod Pest Mgmt

Principles and techniques designed to reduce pest levels below those causing injury of economic importance to agriculture and forestry. Course objectives are to provide students with background information which will enable them to formulate comprehensive approaches to pest problems and emphasize alternate methods of pest control and integrated approaches to pest problems. Appropriate for graduate students in entomology, plant protection, and related curricula.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENT 5234:

Managing Arthropod Pests

Principles and techniques for reducing pests in agriculture and forestry. Concepts of pest management to enable students to formulate comprehensive approaches to solving pest problems. Integrated pest management of primarily North American crops. Pre: Two semesters of biology or two years experience in agriculture production, industry or policy. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENT 5264:

Biological Control of Arthropod Pests and Weeds

Principles involved in the use of indigenous and introduced biological agents in the regulation of arthropod pests and weeds. Course objectives are to emphasize concepts important in biological control: population dynamics, host-parasite interactions, characteristics of parasitism and predation, principles involved in current biological approaches to pest control, and use of biological agents to control weeds. Suitable for students in entomology, plant protection, and related curricula.

Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENT 5324:

Genomics of Disease Vectors

An in-depth examination of the modern approaches and techniques currently employed to study genomes of arthropod vectors of human, animal, and plant diseases. Topics include: genome organization, regulation, and evolution; preparation and analysis of chromosomes; genome mapping, sequencing and assembly; principles of taxonomy and systematics; adaptation and evolution of anthropod vectors; genetics of vector competence; comparative genomics and bioinformatics. Graduate standing required.

Credit Hour(s): 0 OR 2
Lecture Hour(s): 0 OR 1
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENT 5404:

Insect Evolution and Diversity

Examination of major evolutionary events of the arthropod tree of life, focusing on terrestrial arthropods with an emphasis on insects, millipedes, centipedes, arachnids (such as spiders, harvestmen, and scorpions) and close relatives. Review arthropod morphology. Identification of insect specimens to the species taxonomic level, and arthropods to class. Current approaches for taxonomy and how new species are named and classified. Building and curating an insect collection and best practices of natural history museums. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s): ENT 5114
Corequisite(s):

ENT 5624:

Animal and Plant Biosafety and Biosecurity

Principles, tools, and techniques of disease detection, early warning, and containment of animal and plant pathogens. Regulatory agencies and guidelines used to ensure the biosafety and biosecurity of the US food supply from accidental introductions and potential bioterrorism.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENT 5904:

Project and Report

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

ENT 5974:

Independent Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

ENT 5984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 0 TO 10
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

ENT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENT 6004:

Advanced Topics in Entomology

In depth presentations and discussions on selected advanced topics in entomology. (Maximum 4 C per course).

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENT 6154:

Insect Physiology

Detailed study of the physiology and biochemistry of insect organ systems. Topics include: circulation, digestion, respiration, excretion, hormonal regulation, pheromones, intermediary metabolism, and nerve and muscle physiology. Laboratories provide exposure to instrumentation and techniques used in physiological research.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): ENT 5114, CHEM 2535, CHEM 2536

Corequisite(s):

ENT 6164:

Insecticide Toxicology

Concepts and techniques of insecticide chemistry, toxicology, pharmacology, mechanism of action, metabolism, and resistance of small molecule insecticides. Biotechnology and pest management. Registration and renewal of insecticides. Non-target toxicity of insecticides (primarily to mammals). Environmental fate and risk assessment of insecticides. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

ENT 6354:

Insect Behavior and Ecology

Concepts, theory, and research techniques in insect behavior and ecology. General ecology including population, spatial, and community ecology; foraging behavior; communication systems; reproductive behavior and ecology; population regulation by natural enemies; social behavior; and population management using concepts of applied ecology.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): ENT 5114

Corequisite(s):

ENT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 0 TO 10

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ENT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENVIRONMENTAL DESIGN AND PLANNING

Georg Reichard, Head

Professors: Brian Kleiner; Andrew McCoy; Georg Reichard; Walid Thabet;

Associate Professors: Abiola Akanmu; Thomas Mills; Annie Pearce; Tanyel Turkaslan Bulbul; Lu Zhang;

Assistant Professors: Kereshmeh Afsari; Philip Agee; Xinghua Gao; Nazila Roofigari-Esfahan; Alireza Shojaei kol kachi; Ruichuan Zhang;

Collegiate Associate Professors: Josh Iorio;

Graduate Contact: bc-grad-admin-g@vt.edu

General Contact: bbratton@vt.edu

EDP Homepage: https://www.bc.vt.edu/graduate/phd

Graduate Guidebook: https://www.bc.vt.edu/graduate/guidebook

The Environmental Design and Planning (EDP) program at Virginia Tech prepares doctoral students with the professional and academic skills to address the challenges of creating and maintaining tomorrow's built environment. The Doctor of Philosophy degree offers the opportunity for advanced studies and research in specialized areas relating to building design, construction, and operations, providing the basis to contribute to the field from positions in either industry or academia. Applicants must demonstrate the capability to undertake advanced academic studies including independent research. While a prior related degree in the field and industry experience are not required for admission, applicants must demonstrate relevant background and capabilities to succeed at the advanced study level. A minimum of 90 credit hours is required with a minimum of 27 hours of core coursework.

SPECIAL FACILITIES

Bishop-Favrao Hall (BFH) is a 31,600 square foot laboratory facility opened in 2008. It is the home of the Myers-Lawson School of Construction and the Department of Building Construction. BFH was designed to be used as a teaching tool. The structural elements that are usually hidden behind walls and ceiling panels in other buildings are exposed and labeled. That means students can clearly see the structures and systems they are studying in use. All public spaces and all offices have exposed ceilings to allow students and visitors to see the structural, mechanical, electrical, plumbing, fire protection, and electrical systems. The building was specifically designed with large open work spaces, conference and meeting rooms in order to foster a collaborative atmosphere, and flexible spaces available in this building range from two 100-person classrooms to 10-person conference rooms and reconfigurable studio spaces. The building is also home to multiple research labs and centers dedicated to inventing the future of the human-centered built environment. In addition to state-of-the-art research facilities, the building contains administrative, faculty, and graduate student offices. Bishop-Favrao Hall was made possible by numerous Building Construction alumni and friends, many of whom are noted on the donor wall located in the second floor lobby and on plaques around the building. The building is named after Richard Bishop and William A. Favrao. Address: 1345 Perry St. | Map Grid: K-3 Originally Built: 2007 | Abbreviation: BFH

ARCaDe Lab

The Automation & Robotics in Construction And Design (ARCaDe) Lab mission is to advance research and development in the next generation built environment technologies leveraging innovative solutions for design, construction, and operations of buildings and infrastructures. The ARCaDe Lab at Virginia Tech is involved in collaborative interdisciplinary research between the College of Architecture and Urban Studies and the College of Engineering to develop new solutions for the Architecture, Engineering, Construction, and Operations (AECO) industry. Key areas include integration of automation, robotic technologies and control systems, smart buildings and infrastructure, and cyber-physical systems.

BEST Lab

The Building Enclosure and Systems Technologies (BEST) Lab focuses on building science related topics around environmental building systems and enclosure systems and their interrelated thermal, hygrothermal, and acoustic performance, as well as performance aspects of mechanical, electrical, and lighting systems. This lab contains a full-scale building assembly test chamber as well as a variety of portable equipment for monitoring and measuring building conditions, including lighting, indoor air quality, as well as interior and exterior environmental conditions.

BuildLAB

The BuildLAB is a 6,000 square foot fabrication facility equipped for digital design and construction, this lab focuses primarily on wood and composite materials. The lab includes a full spectrum of portable and fixed conventional construction equipment, computer controlled additive and subtractive manufacturing tools, and a trailer-mounted field office and tool storage unit that can be used for projects off-site.

SFI Lab

The Sustainable Facilities & Infrastructure (SFI) Lab is a distributed lab that focuses on the study of sustainable technologies and systems in the built environment and the human systems with which they interact. The lab's equipment includes renewable energy feasibility assessment equipment, a portable audience-interactive charrette facilitator's kit, and a building condition assessment toolkit used to evaluate building performance and conditions in the field.

Smart Systems Lab

The Smart Systems Laboratory at Virginia Tech is a research group focused on basic and applied research on the design of decision support systems, cyber-learning and educational technologies with applications to workforce health, safety and technical training, smart education, smart buildings, and cyber-physical construction systems. These research efforts are largely interdisciplinary and draw upon tools from optimization, machine learning, statistics, sensing systems, and immersive technologies (virtual, augmented, and mixed reality) to embed intelligence into the design, construction, and maintenance of building and civil infrastructure systems.

VCHR

The Virginia Center for Housing Research (VCHR) -the official housing research center for the Commonwealth of Virginia, VCHR provides housing-related data services and analysis to local government, the Commonwealth, and other organizations.

VFRL

The Virtual Facilities Research Lab includes a 250 square foot visualization space as well as other spaces throughout Bishop-Favrao Hall. With a focus on Building Information Modeling (BIM), the lab explores challenges related to interoperability, design for safety, asset and facility management, and simulation.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

GRE

Verbal + Quantitative Reasoning: Minimum (305.0)

TOEFL

Paper: (620.0)

iBT: (105.0)

IELTS

Overall: Total (7.5)

The Environmental Design and Planning (EDP) program at the College of Architecture and Urban Studies at Virginia Tech prepares doctoral students with the professional and academic skills to address the challenges of creating and maintaining tomorrow's built environment. The Doctor of Philosophy degree offers the opportunity for advanced study and research in specialized areas relating to building design, construction, and operations, providing the basis to contribute to the field from positions in either industry or academia. All applicants to the EDP Program must demonstrate the capability to undertake advanced academic studies including independent research. While a prior degree in construction-related fields or construction industry experience is not required for admittance, applicants must demonstrate relevant background and capabilities to succeed at the advanced study level. A minimum of 90 credit hours is required with a minimum of 27 hours of coursework. Students must also successfully complete the Qualifying and Preliminary Exams, Proposal Defense, and Dissertation Defense to meet all degree requirements. GRE Requirements : GRE scores are required for all applicants. TOEFL Requirements : TOEFL scores are required of all international applicants who have not matriculated from an English-speaking university. A minimum score of 105 of the iBT is required for this language-intensive program. Application Deadlines : All required documents must be received in the Graduate School by the application deadline in order for the application to be complete. The Environmental Design & Planning program primarily expects applications for the fall terms. Students interested in beginning the Ph.D. program during other terms should contact the Department of Building Construction for additional information. The Department typically conducts admission reviews and makes decisions within one month after the application deadline. Early reviews and admission decisions can be requested based on faculty recommendations. The deadlines below are the latest possible dates that an application will be considered for fall admission. Students wishing to be considered for funding should directly contact faculty as soon as possible with whom they are interested to work to discuss their interests and funding needs. Funded Students: Students wishing to be considered for funding must apply no later than April 1st for Fall admission. Applications received before January 1st will be considered for early decision funding with decisions being available on January 15th. International Students : The application deadline for international Ph.D. applicants is April 1st for fall admission. Most department decisions will be made by April 15th. Domestic Students : The application deadline for domestic Ph.D. applicants is July 1st for fall admission. Decisions are anticipated to be made by July 15th.

GRADUATE COURSES (EDP)

EDP 5184:

Fundamentals of Practice-based Research Methods

Introduction to practice-based research methods and strategies for Environmental Design and Planning disciplines, and their contributions to disciplinary knowledge. Ethics and academic integrity in practice-based research. Tools and methods for framing, mapping, analyzing and evaluating a practice. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 5284:

Advanced Practice-Based Research Methods

Advanced strategies and techniques for practice-based research in Environmental Design and Planning disciplines. Methods to situate research in communities of practice. Appraisal of external influences on practice-based research. Techniques to differentiate practices based on material, operations and methodologies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDP 5184

Corequisite(s):

EDP 5314:

Transformative Triggers in Practice-Based Research

Transformation and its triggers in past and ongoing practice in Environmental Design and Planning disciplines. Transformative trigger case studies in literature. Triggers in past practice and reflection models. Analysis of shifts and gaps in a student's body of work. Application to ongoing practice. Methods of dissemination of transformative trigger research. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 5324:

Tacit Knowledge in Practice-Based Research

Introduction to the epistemology of tacit and implicit conditions of practice in Environmental Design and Planning disciplines. Tacit knowledge and tacit dimensions in the literature. Types and paradigms of tacit knowledge. Implicit premises of practice including cognitive biases and thinking styles. Normative preconceptions such as value propositions. Dissemination modes for tacit knowledge research. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 5334:

Creativity in Practice-Based Research

Introduction to practice-based creativity research in Environmental Design and Planning disciplines. Creativity preconceptions and biases. Conditions fostering creativity. Methods of theorizing creative processes in practice-based research. Evaluation of creativity research in practice-based research literature. Development of advanced oral and written research dissemination modes and formats. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 5344:

Ecologies of Learning in Practice-Based Research

Learning ecologies specific to practice-based research in Environmental Design and Planning disciplines. Basic types, models and functions of practice-based learning. Typology of practice-based collaborations. Frameworks of collective and distributed learning. Public outcome testing and evaluation. Innovation of learning environments using a practice-based research approach. Translation of outcomes into oral and written presentations for research dissemination. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

EDP 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 6005:

Seminar in Environmental Design & Planning

Historical context for, and nature of, research in fields encompassed by environmental design and planning; theoretical underpinnings and methodological approaches; current research directions; and selected case studies of research projects.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 6006:

Seminar in Environmental Design & Planning

Historical context for, and nature of, research in fields encompassed by environmental design and planning; theoretical underpinnings and methodological approaches; current research directions; and selected case studies of research projects.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDP 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ENVIRONMENTAL ENGINEERING

Mark Widdowson, Head

Emeriti Faculty: Gregory Boardman; William Cox; David Kibler; John Novak; Clifford Randall; Dusan Teodorovic;

Professors: Andrea Dietrich; Marc Edwards; Daniel Gallagher; Stanley Grant; Jennifer Irish; William Knocke; John Little; Linsey Marr; Amy Pruden-Bagchi; Peter Vikesland; Mark Widdowson;

Associate Professors: Hosein Foroutan; Erich Hester; Gabriel Isaacman-VanWertz; Kyle Strom;

Assistant Professors: Jingqiu Liao; Landon Marston; Megan Rippy; Siddharth Saksena; Invalid Use 906564030 David Munoz Pauta;

University Distinguished Professor, Charles P. Lundsford Professor: Linsey Marr;

W. Thomas Rice Professor and University Distinguished Professor: Amy Pruden-Bagchi;

Nick Prillaman Professor: Peter Vikesland;

University Distinguished Professor: Marc Edwards;

Charles E. Via, Jr. Professor: John Little;

Assistant Professor of Practice: Robert Scardina;

Associate Professor of Practice: Claire White; Kevin Young;

Graduate Contact: shmartin@vt.edu

Extended Campus: shmartin@vt.edu

Graduate Site: https://cee.vt.edu/Graduate-menu/prospective_graduate_students.html

Graduate Student Policy Manual: https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

The Environmental Engineering (ENE) Program of the Department of Civil and Environmental Engineering offers graduate study leading to the MS in environmental and water resources engineering and the PhD in civil engineering (with an environmental and water resources engineering emphasis). The program goals are to educate and prepare engineers for careers in the various fields of environmental engineering design, water supply management, site remediation, environmental modeling, pollution control engineering, water resources engineering, and public health protection. The MS in environmental engineering is open to students from all undergraduate engineering curricula or in a related field of science such as Biology, Chemistry, Mathematics, Soil Science, Statistics or Geology. It is specifically designed to build upon undergraduate degrees in civil, biological systems, chemical, mechanical, and mining engineering. Within a few years of program completion, graduates of the ENE program should be able to combine skills gained through academic preparation and post-graduation experience so that they can: Exhibit technical competence through application of engineering knowledge problem-solving skills, and modern tools from multiple areas of environmental engineering practice in the analysis, evaluation, design, and construction of environmental engineering systems and system components. Apply skills of effective communication, teamwork, leadership, and professional and ethical behavior as complements to technical competence. Incorporate economic, environmental, social, and sustainability considerations into the practice of environmental engineering. Continue their technical and professional development, which may include professional licensure, graduate level education, continuing education courses, self-directed study, and participation in conference and committee activities. Please refer to the Civil and Environmental Engineering listing for more detailed information on the CEE Department, the academic "home" of the ENE program.(http://www.cee.vt.edu/).

SPECIAL FACILITIES

The ENE program offers a variety of labs space for students to conduct research as part of their degree program. The Kelso Baker Environmental Hydraulics Laboratory (BEHL) and the Occoquan Watershed Monitoring Laboratory (OWML) in Manassas, VA and the Potomac Aquifer Recharge Monitoring Laboratory (PARML) in Hampton, VA are among the labs available to students.

Computing Facilities

The Civil and Environmental Engineering Computer Lab (CEECL) is maintained as a state-of-the-art, collaborative learning environment. The instructional lab provides excellent multimedia equipment for faculty to demonstrate and instruct students in the use of computing tools through the Department's curriculum. Faculty and students also have access to a variety of supercomputing facilities and data visualization capabilities through the computer resources of Virginia Tech.

Experimental Facilities

The environmental engineering program occupies modern laboratories in Durham, Kelly, Steger, Patton and Hancock Halls. Laboratories and specialized experimental and analytical equipment support research programs related to areas such as water and wastewater treatment, hazardous and residuals waste management, water quality management, environmental chemistry, and air quality. Available equipment allows for the identification and quantification of most chemical and microbial environmental contaminants. The water resources engineering laboratories support basic and applied research activities in the areas of water, sediment, and pollutant movement in surface and groundwater sources. The Kelso Baker Environmental Hydraulics Laboratory houses two large (each 70 ft. long) tilting flumes, a medium length tilting fume, a 3-D laser Doppler velocimeter, a hot film anemometer, and numerous pieces of support instrumentation.

Occoquan Watershed Monitoring Laboratory (Manassas, Virginia)

The Occoquan Watershed Monitoring Laboratory (OWML), Manassas, is responsible for making determinations in a number of areas critical to the ongoing management of water quality in the Occoquan watershed, situated on the southwestern periphery of the Virginia suburbs of Washington, D.C. The basin encompasses six political subdivisions, including portions of four counties, and the entire land area of two independent cities. The lab is also the site of a National Science Foundation Growing Convergence Research center on reversing inland freshwater salinization (https://salt.cee.vt.edu/).

Potomac Aquifer Recharge Monitoring Laboratory

T he PARML, Hampton, is responsible for making determinations in a number of areas critical to the ongoing management of water quality in the Potomac aquifer, situated in the Hampton Roads area of Southeast Virginia. This work is in association with managed aquifer recharge associated with the $1 billion SWIFT (Sustainable Water Initiative For Tomorrow) project.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

iBT: overall (90.0), subsections (each has a minimum score) (20.0)

The purpose of the core curricula is to develop an understanding of the applicable chemical, physical, biological, and mathematical modeling fundamentals and then teach student how to apply these principles in a broad range of applied courses. Specialization can be in the traditional areas of air quality engineering, environmental modeling and simulation,environmental nanotechnology, hazardous waste management, water infrastructure, water resources engineering and water and wastewater process engineering. Emerging thrust areas include sustainable water supply and water reuse, water infrastructure and environmental nanotechnology. The MS ENE degree may be taken either as coursework only or with the permission of the faculty may incorporate a research thesis. The PhD program in Civil Engineering is designed to build upon the MS in environmental engineering, but also is open to students with master's degrees in other engineering disciplines. Areas of specialization are the same as for the MS degree, but the program of study are more individualized. See Departmental Manual at https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

GRADUATE COURSES (CEE)

CEE 5004:

Adaptive Reuse and Redevelopment

Principles and practices for adaptive reuse and redevelopment. Value capture and creation from obsolete and underperforming infrastructure systems and facilities. Life cycle cost considerations with a focus on end of useful life decisions. Strategies for circular economic thinking and triple bottom line metrics. Risk assessment and regulatory constraints for adaptive reuse, brownfield redevelopment, and changing societal and environmental demands. Construction technologies and project management for integrated design, modular construction, and future reuse and disassembly. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5010:

Schedule Impact Analysis

Analysis of construction scheduling principles, scheduling specifications, contract administration, construction law, construction delay claims, and of accepted methodologies for performing schedule impact analysis of delaying events. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5014:

Facility Delivery & Financing

Delivery and financing of constructed facilities with an emphasis upon civil infrastructure systems. Design of project delivery systems to encourage best value, innovation, and private sector participation. Public-private partnership strategies and factors that contribute to success or failure. Fundamentals of project feasibility, evaluation, and finance. Case studies of large-scale infrastructure projects. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5020:

Infrastructure Policy

Infrastructure policy and briefs. Policy implications for civil infrastructure. Community empowerment challenges of fair housing, climate change, urbanization, environmental justice. Communication in socio-technical infrastructure systems. Community engagement with policy makers. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5024:

Contract Administration and Claims Resolution

This course provides students with a knowledge of the different types of contracts used in civil engineering construction. Contracts are viewed as documents which assign responsibilities and allocate risks and emphasis is placed on contract administration as the first step in reducing costs and easing the burden of dispute resolution. Techniques for quantifying and resolving claims are studied.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5034:

Smart Sustainable Infrastructure

Challenges and barriers to sustainable infrastructure. Effects of a changing planet and society on infrastructure. Technology and data use for engineering. Infrastructure data interpretation. Data-driven engineering solutions. Merit and appropriateness of engineering solutions. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5044:

Construction Management Principles

Principles of construction project planning, economics, scheduling, execution and controls. Project delivery methods, procurement processes, and contract types. Valuation of project cash flows over time. Productivity and cost of equipment operations. Conceptual and detailed estimating methods. Scheduling methods for project planning, resource management, execution and control. Contemporary and professional topics. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

CEE 5060:

Built Environment Information Modeling and Processing

Introduction to technologies that enable virtual modeling and processing of the infrastructure project life cycle. Introduction to theory and application of Building and Civil Information Modeling (BIM and CIM), and their integrated practices for the architectural, engineering and construction industries. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5074:

Global Virtual Design and Construction

Fundamental aspects of modern civil engineering project execution in virtual workspaces. Participation in team-based virtual design and construction project involving students from other domestic and international universities. Design of organizational and task model, integration with design and cost models, identification of interventions that improve scheduling. Strengthened ability to work collaboratively with individuals from different countries/cultures. Both theory and practice emphasized. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5080:

Infrastructure Asset Management

Comprehensive systems approach to civil infrastructure system and strategic-level asset management with emphasis on municipal, highway, building, dam, and bridge infrastructure. Course will cover various aspects of strategic-level infrastructure asset management: systems thinking, needs assessment, information technology and GIS data management, risk and reliability engineering, multi-criteria decision making process, infrastructure sustainability and resiliency, and renewal engineering (repair, rehabilitation, and replacement). Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5084:

Information Technology for Infrastructure and Environment Systems

With the acceleration of the process of global revolution in science, engineering and technology led by information technology, the human society is in a gradual transition from an industrial society into an information society. As a new productivity with the greatest potential at the present age, information technology has undergone great development. The incessant innovation in technology has also urged people to make better use of it and apply advanced information technology to their own industry. In recent years, Information Technology (IT) and Cyber Infrastructure has been transforming engineering and business practices in many sectors, resulting in efficiency gains and improved services for the client. The infrastructure industry has been slow to utilize information technology effectively and slower still to grasp the ways in which the multitude of design, calculation, specification, project management, asset management, sensor technology, database and data analysis software applications relate to each other. This course provides an overview of the range of Information Technology (IT) applications available to the civil and environmental professional throughout the life cycle of a project, from data collection and analysis through software, project management, environmental impact analysis, visualization, and infrastructure asset management. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5094:

CII Best Practices

Introduction to Construction Industry Institute (CII) Best Practices, including Front End Planning Zero Accident Techniques, Constructability, and Material Management that affects construction projects. Management influences on construction processes and critical issues. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5100:

Stormwater Treatment

Stormwater quality. Basic traps, basins, and filters. Stormwater treatment. Basic vegetative control systems. Mechanistic role of wetland. Best management practices. Monitoring, sampling, analysis, and maintenance methods. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5104:

Environmental Chemistry

Applied, environmental aspects of physical, organic, and inorganic chemistry; including applications in sanitary engineering of the phenomena of precipitation, complexation, buffering capacity, and chemical equilibria. Review of the nomenclature and properties of organic compounds.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5114:

Advanced Environmental Sustainability - A Systems Approach

Advanced quantitative methods to evaluate environmental sustainability using a systems approach. Sustainability assessment frameworks, indicators of sustainable development, green-house gas emissions, renewable energy systems, whole-system design, economic systems

and input- output techniques, system dynamics models, emergence and agent-based models. Emerging sustainability topics. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5120:
Emerging Tools for Environmental Field Research
Development and use of custom measurement tools using microcontrollers, low-cost sensors, and emerging technologies. Evaluation of the capabilities, limitations, and specifications of sensors. Design and execution of real-world environmental research with low-cost environmental sensing technologies. Acquisition interpretation of analog and digital data from an environmental sensor. Troubleshooting a circuit and instrument. Design, construction, and use of a prototype instrument. Experimental design for real-world field research. Propose, evaluate and optimize a prototype instrument. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5125:
Environmental Engineering Design
5125: Design of wastewater treatment facilities for the reduction and elimination of organic and inorganic pollutants; 5126: Design of water treatment facilities for the production of potable waters from surface and groundwater systems. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5126:
Environmental Engineering Design
5125: Design of wastewater treatment facilities for the reduction and elimination of organic and inorganic pollutants; 5126: Design of water treatment facilities for the production of potable waters from surface and groundwater systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5130 (ESM 5554):
Turbulence and Turbulent Flows
Nature and origin of turbulence, turbulent transport of momentum and heat, the dynamics of turbulence, statistical description of turbulence and spectral analysis. Examples of turbulent flows, boundary layers.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5134:
Engineering Aspects of Water Quality
The application of biological, chemical, and physical principles of water quality to engineering problems in surface waters. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5144:
Unit Operations and Processes Laboratory
Applied science aspects of water and waste treatment; advanced research techniques in analysis and treatment of water and wastes.
Credit Hour(s): 3
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s): (CEE 5125 (UG) OR CEE 5126 (UG)) OR (CEE 5125 OR CEE 5126)
Corequisite(s):

CEE 5150:
Atmospheric Chemistry
Fundamental physical and chemical systems in the atmosphere. Chemical reactions between atmospheric constituents. Chemical

processes that form, transform, and remove pollutants in the atmosphere. Structure and composition of the atmosphere. Oxidation of natural and anthropogenic emissions. Aqueous and organic aerosol chemistry. Interactions between gases and particles. Human influence on atmospheric processes. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5154:

Air Pollution Transport and Chemistry

Air pollutant emissions, transformation, transport, and fate. Global climate change, ozone chemistry, air pollution modeling, particle dynamics, and air quality management. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5164:

Environmental Biotechnology

Introduction to environmental biotechnologies for wastewater treatment. Fundamentals of environmental microbiology. Engineering principles for applying biotechnology to address environmental pollution control. Advanced biotechnologies, membrane bioreactors, and algal bioreactors. Sustainable environmental remediation and protection. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5174:

Applied Analytics for Environmental Science and Civil Engineering

Programing in multiple languages. Control structures for curating and manipulating data, user defined functions, implementation of data analysis packages, generation of publication quality graphics. Probability distributions, parametric and nonparametric bootstrapping. Nonparametric confidence bounds and prediction intervals for simple, multiple and generalized linear regression. Multivariate techniques including cluster analysis, classification and regression trees, principal component analysis, correspondence analysis, redundancy analysis, canonical correspondence analysis. Application to environmental science and engineering datasets. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5184:

Techniques for Environmental Analysis

An introductory course on techniques commonly utilized for analysis of environmental samples. Course will discuss gas and liquid chromatrography, mass spectrometry, and atomic absorption spectroscopy, focusing on analysis of complex environmental samples. Practical techniques and applications are emphasized, but sufficient theory is introduced to provide students with an understanding of the principles involved.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5194:

Environmental Engineering Microbiology

Roles of microorganisms in wastewater treatment, anaerobic digestion of municipal sludges, stream self-purification, and degradation of water quality in drinking-water systems. Disinfection of wastewater and drinking water to remove viruses, bacteria, and protozoa that cause waterborne disease.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5204:

Gis Applications in Civil Engineering

Examination of data structures used in geographic information systems. Map projections and coordinate systems used in mapping. Database creation, maintenance, and integrity. Applications of GIS methods for solving civil engineering problems in land management and related

areas.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5244 (BSE 5244):

Advanced GIS in Hydrologic Analysis

Advanced GIS course focusing on raster analysis with particular application to the issues associated with hydrologic analysis. Application and evaluation of algorithms for terrain analysis, watershed characterization, and hydrologic analysis and modeling as implemented in GIS. Digital elevation data sources and error assessment. Approaches to GIS/model integration and application. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5254:

Municipal Engineering

Field of municipal engineering. Infrastructure, capital projects, financing, sustainability, disaster planning and response, and municipal plan review techniques. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5264:

Sustainable Land Development

Contemporary techniques for developing land while maintaining a focus on long-term sustainability. Smart location and linkage, neighborhood pattern and design, conceptual design, stormwater strategies, green buildings and energy. Development standards such as Leadership in Energy & Environmental Design (LEED) and Envision. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5264G:

Advanced Air resources Engineering

Effects, regulation, sources, and control of air pollution. Application of engineering calculations and models to estimate emissions, predict pollutant concentrations, and design pollution control equipment.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5274:

Land Development Design Projects

Analysis of land development projects. Land development industry,government policies and regulations, legal topics, engineering design, and construction practices. Site feasibility analysis, site planning, environmental compliance, conceptual layout, and ADA compliance. Design of major infrastructure systems. Use of computer aided drafting and design software. Design project. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5304:

Environmental Fluid Mechanics

The first part of the course will be devoted to basic concepts and equations of fluid motion. The remainder of the course will be concerned with the theory of incompressible viscous and inviscid fluids. Selected applications will be drawn from environmental and water resources topics. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5314:

River Mechanics and Sediment Transport

Sediment properties; critical stress; bed-form regimes in alluvial streams;

depth-discharge relations for rivers; bed load and suspended load movement; river stability; flow in bends; river training. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5334:

Analysis of Water Resources Systems

Introduction to quantitative hydrology. Diverse computational aspects within watersheds. Methods and models used to examine components of hydrologic cycle. Risk analysis and statistical probability in hydrology. Comprehensive models for watershed management and urban hydrology. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5344:

Surface Water-Groundwater Interaction

Interaction (exchange) of surface water with groundwater at watershed, reach, sediment-patch scales including bidirectional hyporheic flows. Focus on streams and rivers, consideration of lakes. Steady and unsteady exchange hydraulics including laminar and turbulent flows. Exchange benefits and engineering goals including heat transfer, nutrient processing, and contaminant attenuation. Engineering applications including conjuctive use of surface water and groundwater resources and impact of groundwater pumping on rivers. Field methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5354:

Numerical Modeling of Groundwater

Theory and practice of numerical techniques are developed and applied to fluid flow and transport in ground-water flow systems. Governing equations are formulated using FD and FE techniques with appropriate BCs and ICs. Additional topics include: model conceptualization and grid design in multidimensional systems; practical applications of numerical models including calibration, validation, and prediction; concepts and techniques of advective transport using particle tracking and dispersive transport. Introduction to MODFLOW, MODPATH, MT3D, and others. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5374:

Dynamics Groundwater

The theory of dynamics of fluids in porous media; fluid and matrix properties; transport equations; boundary and initial value problems; flow of immiscible fluids; dispersion. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5384:

Advanced Open Channel Flow

Advanced treatment of the mechanics of open channel flow, including uniform flow, gradually varied flow, channel transitions, and unsteady flow. Independent research project. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5390:

Advanced Urban Water Sustainability

Climate change and the supply of freshwater. Coupled socio-hydrologic feedback loops (systems dynamics models) and implications for water systems resilience. Urban water transitions theory and the evolution of water systems through time. Water productivity. Stormwater capture and reuse, green stormwater infrastructure, and ecosystem services. Decentralized water and wastewater treatment systems. Emphasis is placed on the social (equity), environmental, and technological context in which urban water systems operate. Advanced statistical computing is used to quantitatively explore urban water systems challenges. Pre:

Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5400:

Design of Prestressed Concrete

Principles of prestressing applied to single and multiple span concrete beams, beams with composite slabs, and two-way slabs. Design of individual elements of prestressed concrete for allowable stresses, flexural strength and shear that satisfy industry standards. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5410:

Intermediate Reinforced Concrete Structures

Behavior and design of reinforced concrete structures subjected to gravity and lateral loads. Moment-curvature relationships for reinforced concrete beams with and without confinement. Collapse mechanisms and redistribution in continuous members. Development length, slender columns, two-way floor systems, and combined shear and torsion. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5414:

Finite Element Analysis of Structures

Formulation of the finite element method and application to skeletal, plate, and shell structures. Study of mesh layout and refinement, convergence characteristics, and solution accuracy. Tests of element quality. Use of commercial finite element codes such as ABAQUS.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5420:

Computer Methods of Structural Analysis

Formulation of the matrix displacement method in a form suitable for program development. Application to trusses, continuous beams, grids, and frames. Incorporation of special features such as constraints, rigid ends, internal releases, and support settlements. Initiation and modification of existing programs on the personal computer. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5430:

Intermediate Design of Steel Buildings

Design of major components in steel-framed buildings, including composite beams and slabs, beam-columns, and moment connections. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5440:

Instrumentation and Signal Processing for Civil Engineering Applications

Fundamental operating principles and implementation guidelines for instrumentation in civil engineering. Measurements for strain and load, acceleration, temperature, pressure. Data acquisition and signal processing concepts, sampling, filtering, and frequency domain analysis. Statistics, uncertainty analysis, and experimental methods applied to sensor measurements. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5444:

Stability of Structures

Methods of static structural stability analysis and their applications. Buckling of columns and frames. Energy method and approximate solutions. Elastic and inelastic behavior. Torsional and lateral buckling. Use of stability as structural design criterion. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5450:

Forensic Struct Engineering

Cultural and technical basis for concepts of risk and failure, formal approaches to failure investigation, origins of natural and man-made disasters, the role of building codes, standard of care, ethical standards, community resiliency, and legal issues as related to forensic structural engineering. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5454:

Blast Resistant Design of Structures

Explosion sources and blast waves. Computation of blast load parameters. Single degree of freedom dynamic analysis of blast loaded components. Material behavior at high strain rates. Protective design and detailing of concrete and steel structures and non-structural components. Retrofitting and hardening of existing structures. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5464:

Structural Dynamics and Earthquake Engineering

Earthquake-induced vibration of single- and multi-degree-of-freedom systems; application to frames and to shear and torsional buildings; response spectrum analysis; building codes; static and dynamic lateral force procedures; seismic resistance of steel and concrete building frames. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

CEE 5470:

Structural Design for Seismic Load Effects

Analysis and design of steel and reinforced concrete structures for seismic load effects. Fundamental principles of earthquake engineering, as rooted in seismic hazard analysis, inelastic behavior, and dynamic response. Application of these principles to the design and detailing of reinforced concrete and structural steel buildings. Building code requirements for seismic loading and seismic resistant design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   CEE 5464

Corequisite(s):

CEE 5474:

Advanced Reinforced Concrete Design

Limit design concepts, yield-line methods, seismic considerations, and other advanced topics related to design of reinforced concrete structures. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5480:

Steel Bridge Design

Design and analysis of primary bridge components including concrete decks, steel plate girders, and bracing members. Moving loads, and load combinations specific to bridges using current design codes. Fatigue and fracture limit states from repetitive vehicular loads. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5484:

Concrete Microstructure

Modern cement production. Composition and hydration mechanisms of concrete and other cementitious composites. Micro- and nanostructural development of fresh and hardened concrete. Effects of chemical admixtures, mineral fillers, and supplementary cementitious materials. Application of advanced characterization techniques to cement and concrete microstructure. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5490:

Structural Mechanics

Mechanics of civil materials and structural components. Fundamentals of elasticity. Bending of beams, beam-columns, and thin plates. Energy methods for boundary value problems. Stability conditions. Failure criteria, introductory fracture mechanics, and plasticity theories. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5494:

Reliability Methods in Structures and Mechanics

Theory of structural reliability; reliability based designs, safety index, linear and nonlinear design equations, load and resistance factors, Level I, II and III formats, code formulations; systems reliability, bounds on reliability.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5500:

Numerical Methods in Geotechnics

Numerical modeling of geotechnical systems. Numerical methods in geotechnics. Finite element method, formulation of boundary value problems, principles of coupled hydromechanical analysis. Structure and use of finite element software.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5504:

Risk Analysis Geotechnical Engineering

Methods for risk analysis of complex systems. Basic concepts of probability and reliability applied to geotechnical engineering problems. Geostatistics concepts. Probabilistic seismic hazard analysis and performance based design. Computational tools and simulation methods. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5510:

Thermal and Energy Geotechnics

Thermal properties of soils. Laboratory and in-situ thermal tests. Temperature effects on soil behavior. Design of thermo-active foundations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5514, CEE 5544

Corequisite(s):

CEE 5514:

Soil Behavior

Behavior of soil examined from a fundamental soil perspective. Review of methods of testing to define response; rationale for choosing shear strength and deformation parameters for soils for design applications. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5524:

Advanced Soil Testing for Engineering Purposes

Methods of testing and analysis of soil for engineering properties including compressibility; strength in triaxial, simple, and direct shear; permeability; and stability. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5534:

Foundation Engineering I

Behavior and design of retaining walls and shallow foundations. Earth pressures, bearing capacity, and settlement. Stress distribution and consolidation theories. Settlement of shallow foundations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5544:

Foundation Engineering II

Behavior and design of anchored bulkheads, excavation bracing, driven piles, drilled piers and buried structures. Effects of pile driving. Response of deep foundations to vertical and horizontal loads.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5534 (UG) OR CEE 5534

Corequisite(s):

CEE 5554:

Soil and Site Improvement

Methods of soil and site improvement including design techniques for dewatering systems, grouting, reinforced earth, in-situ densification, stone columns, slurry trenches, and the use of geotextiles. Construction techniques for each system are described. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5564:

Seepage and Earth Structures

Soil permeability and seepage through soils. Embankment design. Compaction, earth pressures and pressures in embankments. Slope stability analysis. Settlements and horizontal movements in embankments. Landslide stabilization.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5514 (UG) OR CEE 5514

Corequisite(s):

CEE 5584:

Geotechnical Aspects of Earthquake Engineering

Causative mechanisms of earthquake, earthquake magnitudes, ground motion, effect of local soil conditions on motions. Response of soils to seismic loading, liquefaction phenomena and analysis of pore pressure development, laboratory and in-situ testing for seismic loading. Analysis and design of slopes, embankments, foundations, and earth retaining structures for seismic loading. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5594:

Geological Engineering

Mechanical and hydraulic properties of rock masses; analysis and design of rock foundations, slopes, tunnels, and other forms of civil infrastructure; rock reinforcement. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5600:

Civil Infrastructure Systems Analysis

Systems analysis, modeling infrastructure systems by mathematical programming, measuring infrastructure systems performances, probabilistic analysis of infrastructure systems, multiple attribute decision making in infrastructure systems. Pre: Graduate standing in engineering is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5604:
Traffic Characteristics and Flow
Driver, vehicle, and roadway characteristics; stochastic modeling of traffic processes including queueing theory, headway distributions, and gap acceptance; stream flow characteristics including car-following and multilane traffic models, roadway capacity and bottleneck analysis, network operations, and fuel consumption models. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5610 (ESM 5044G):
Advanced Mechanics of Composite Materials
Introduction to the deformation, stress, and strength analysis of continuous-fiber-polymer-matrix laminated composites. Fabrication, micromechanics of stiffness and expansional coefficients, classical lamination theory. Environmentally induced stresses. Computerized implementation and design. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5614:
Analysis of Air Transportation Systems
Planning, design and operation of aviation systems with computer aided design tools and computer simulation models. Airline airport operations and practices and their effect in airport planning and design. Air cargo facilities planning and modeling. State-of-the-art computer simulation models used in aviation environmental planning and airspace modeling. Graduate standing in CE required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5624:
Transportation and Land Use
Interaction between transportation and land use variables, including modeling requirements, impacts, and data needs within the context of good community planning and economic development; elements of transportation and land use that shape the quality of life in urban areas. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5634:
Analysis and Planning of Mass Transit Systems
An overview of mass transit systems; transit system planning including demand and cost analysis and evaluation; transit system design including route design, scheduling, and fare policy; transit networks and marketing; para transit systems; future trends in mass transit. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

CEE 5640:
Highway Transportation Safety
Identification of highway safety problems and development of solutions. User characteristics and expectations, road audits, roadside hardware systems, safety enhancing treatments, standard traffic control devices, real-time information and control systems, work zone and railroad crossing treatments, older driver design concepts, traffic calming, designs for pedestrians and bikes, delineation and lighting principles, and advanced 3D/4D design concepts. Group and individual analyses of problems. Pre: Graduate standing in engineering is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5650:

Freight Operations & Planning

Introduction to the operation of modal and intermodal freight facilities and operation. Types of freight movement and handling equipment, freight planning methods, and research. Freight as a multi-modal transportation system. Role of privately owned and operated freight movement on public sector transportation operations and decision making. Communication of impacts of freight movement. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5654:

Critical Issues in Transportation

Technological, societal, economic, political, environmental, health, and energy effects on planning, design, operation, and management of the transportation system. Modeling of complex interactions and causal relationships among current issues. Principles of optimization for design and operation of the five basic elements of transportation (vehicles, networks, terminals, controls, and system administration). Problem definition, objectives identification, model development, alternatives generation and evaluation, and reasoning process for transportation investment. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5664:

Intercity Transportation

Intercity transportation, including trucking, railroads, and aviation industries, as a vital part of the economy. Operation and logistic rules that govern the flow of shipments and dictate costs and freight rates under various regulatory policies and market environments. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 3604

Corequisite(s):

CEE 5694:

Traffic Signal System Operation and Control

Traffic signal system control, with emphasis in arterial operation. Signal system design and operations, traffic simulation techniques, advanced traffic control strategies, and incorporation of surface street systems into Intelligent Transportation Systems (ITS). Hands on experience in signal system software and hardware. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5704 (PHS 5704):

Drinking Water & Health

Drinking water contamination and associated health outcomes. Programs to improve safe water access. Viral, bacterial, protozoal, and helminthic pathogens. Heavy metals, pesticides, and other contaminants. Drinking water treatment and supply in rural areas. Study designs for health outcome assessment. Field-based intervention trials. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

CEE 5714:

Surface Water Quality Modeling

Use, analysis, and development of water quality models for lakes, rivers, and estuaries. Emphasis on model calibration, verification, and post-audit analysis. Lab portion will develop and apply a eutrophication model for an estuary using existing data.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5724:

Environmental Monitoring and Sampling

Experimental design and sampling techniques for environmental analysis, including environmental monitoring techniques and statistical principles for planning monitoring locations and frequencies at environmental sites such as landfills, rivers, lakes, and the atmosphere. Development of monitoring strategy; examination of sampling techniques for various sample types.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): CEE 5104

CEE 5734:

Urban Hydrology and Stormwater Management

Development of methods and numerical models for computing surface runoff from developing watersheds; hydraulics of combined sewer systems; urban non-point source pollutant load calculations and best-management practices; control strategies for regional stormwater management; detention basin design for control of urban floods and non-point source pollutants. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5744:

Topics in Structural Steel Design

Calculation of stresses in steel members. Overall-local buckling interaction. Design of singly symmetrical and unsymmetrical columns and topics on flexural design, design of plate girders, bracing design, and design of framing connections. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5754:

Pavement and Bridge Infrastructure Management Systems

Management concepts used in civil infrastructure; planning, design, construction, maintenance, and rehabilitation of bridge and highway systems. Prioritization, optimization, and decision-making techniques. Life-cycle-cost prediction. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5764:

Asphalt Technology

Origin, types and properties of bituminous materials and their use in civil engineering. Asphalt rheology. Theory behind technological processes and procedures for hot-mix asphalt including design philosophy, performance, and durability. Modern construction with bituminous materials; special mixtures, recycling, and additives. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5784:

Special Topics in Portland Cement Concrete

Advanced tools and approaches for supporting more sustainable transportation infrastructure investment decisions by balancing technical, economic, environmental, and social objectives. Selection of sustainable materials, systems and management approaches. Mitigation and adaptation to climate change. Cost and environmental life-cycle assessment methods and tools pertaining to transportation systems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5794:

Environmental Engineering Principles

Examines the basic physical, chemical, and microbiological principles that provide the foundation for environmental engineering. Illustrates how these principles are applied to solve a wide range of environmental problems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): CEE 5104

CEE 5804:

Engineering Ethics and the Public

Moral obligations of engineers and scientists toward the publics they serve; responsible conduct of research; responsible conduct of practice; the responsibilities and risks of witnessing wrongdoing; the value of non-expert knowledge claims and the importance of listening to public stakeholders. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5814:

Structure-Sediment Interaction

Scour processes at structure foundations in the coastal zone. Erosion and undermining at port walls, pipelines, piers, jetties, breakwaters, artificial reefs. Foundations and moorings for nearshore renewable energy devices. Sediment remobilization and liquefaction as a consequence of cyclic loadings and extreme events. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5834:

Asphalt & Pavement Modeling

Characterization of asphaltic concrete microstructure. Relations to macroscopic properties. Pavement performance modeling. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5844:

Ocean and Coastal Wave Mechanics

Linear wave theory including boundary value problems, wave transformation in shallow waters, long waves, and engineering properties of waves. Introduction to nonlinear wave theories. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5854G:

Advanced Coastal Engineering

Basic wave mechanics principles, surf-zone processes, littoral and sediment processes, shoreline features, astronomical tides, coastal hazards, and functional design of coastal structures. Field trips. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5864:

Coastal and Estuarine Morphodynamics

Sediment transport in marine environments, shoreline change, bedform evolution and morphodynamics, tidal inlet morphodynamics, barrier island processes, storm erosion, delta development, beach dynamics. Evolution of estuarine waterways and wetland systems. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5874:

Coastal and Marine Geotechnics

Geotechnical aspects of coastal and marine engineering. The coastal zone as a working environment. Geotechnical properties of beach and seafloor sediments, methods and processes for subaqueous and coastal site investigations, complementary techniques for investigation. In-situ survey strategies, planning and management. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5884:

Legal Aspects of Civil, Construction and Environmental Engineering

Analysis of relevant federal and state law (commercial law, contracts law, environmental law) in application to the design and construction of civil and/or environmental engineering projects, as well as water and wastewater treatment and management. Professional liability, risk management and environmental regulatory compliance issues. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CEE 5944:

Seminar

Review and discussion of current literature, research, and consulting activities by student, faculty, and guest speakers.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, Online Lecture

Instruction Type(s): Independent Study, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

CEE 6104:

Advanced Environmental Chemistry

Advanced theories and practices in environmental engineering with special emphasis on inorganic aspects of water chemistry; application of water chemistry fundamentals for the description of aquatic systems. Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 6114:

Advanced Topics in Air Quality Engineering

Review and critique of current research. Emissions, transport, transformation, and fate of gases and particles in the atmosphere. May be repeated with different topic content for a maximum of 3 credits. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 6404:

Dynamics of Structures

Formulation of equations of motion by the finite element method. Solution by mode superposition and direct methods. Earthquake analysis and nonlinear analysis. Application to skeletal and plate structures. Development of computer programs and use of commercial programs. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (CEE 5414 (UG), ESM 4074 (UG)) OR (CEE 5414, ESM 4074)

Corequisite(s):

CEE 6414:

Nonlinear Finite Element Analysis for Solids and Stuctures

Nonlinearities encountered in solid and structural mechanics. Finite element formulation of nonlinear truss and beam problems. Nonlinear solid mechanics and plasticity theory. Algorithmic implementation of elasto-plastic constitutive models. Implicit and explicit solution procedures for finite element analysis of nonlinear static and dynamic problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5414

Corequisite(s):

CEE 6424:

Advanced Prestressed Concrete

Behavior and design of prestressed slabs, bridges, and precast building systems. Continuous prestressing; load-balancing method for slabs; torsion and shear; connections for precast members; partial prestressing. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 6434:

Advanced Steel Design

Advanced topics of current interest in structural steel design research as given by recent publications and informal reports. In-depth study of selected projects. May be repeated. 12 credits of 5000-level courses in structures or solid mechanics required. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 6504:

Introduction to Constitutive Modeling of Soil

Constitutive Laws for Soils, nonlinear elastic and plastic models. Consolidation, layered systems, sand drains, approximate three-dimensional theories, and Biots poro-elastic formulation. Plastic equilibrium in soils Sokolovskis method of characteristics, applications to earth pressure, bearing capacity, and slope stability problems. Analysis of machine foundation problems, elastic waves through soils, dynamic properties of soils.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5514 (UG) OR CEE 5514

Corequisite(s):

CEE 6514:

Dynamics of Soils and Foundations

Principles of the dynamics of soils and foundations. Seismic waves. Non-linear dynamic soil behavior and vibrations. Dynamic-soil-structure interaction. Impedance functions and machine foundation design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5584

Corequisite(s):

CEE 6844:

Current Topics in Coastal Eng

Contemporary challenges and research questions in coastal engineering. Review and critique of contemporary coastal engineering literature. May be repeated with different topic content for a maximum of 6 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CEE 5854G

Corequisite(s):

CEE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

CEE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ENVIRONMENTAL SCIENCES AND ENGINEERING

Mark Widdowson, Head

Emeriti Faculty: Gregory Boardman; William Cox; David Kibler; John Novak; Clifford Randall; Dusan Teodorovic;

Professors: Andrea Dietrich; Marc Edwards; Daniel Gallagher; Stanley Grant; Jennifer Irish; William Knocke; John Little; Linsey Marr; Amy Pruden-Bagchi; Peter Vikesland; Mark Widdowson;

Associate Professors: Hosein Foroutan; Erich Hester; Gabriel Isaacman-VanWertz; Kyle Strom;

Assistant Professors: Jingqiu Liao; Landon Marston; Megan Rippy; Siddharth Saksena; Invalid Use 906564030 David Munoz Pauta;

University Distinguished Professor: Marc Edwards;

Charles E. Via Jr. Professor: John Little;

University Distinguished Professor, Charles P. Lundsford Professor: Linsey Marr;

W. Thomas Rice Professor and University Distinguished Professor: Amy Pruden-Bagchi;

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Graduate Site: https://cee.vt.edu/Graduate-menu/prospective_graduate_students.html

Graduate Policy: https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

The Environmental Science and Engineering (ESEN) program is designed to prepare undergraduates with a science background to work with engineers in various fields including, water supply, wastewater management, public health, watershed management, stream protection, groundwater remediation and air resource management. Appropriate disciplines include, but are not limited to biology, chemistry, geology, agronomy, soil science and environmental science. A wide range of courses can be taken to fulfill the degree requirements, depending on the background and interests of the student. The purpose of the core curricula is to develop an understanding of the applicable chemical, physical, biological, and mathematical modeling fundamentals and then teach students how to apply these principles, along with their previous scientific training, to the solution of environmental problems. Appropriate employment is with consulting firms, regulatory agencies, municipalities and industry. The program administratively is under the direction of the Head of the Department of Civil and Environmental Engineering (http://www.cee.vt.edu/) and the program direction is by a faculty committee from Departments in the College of Engineering, Agriculture and Science.

SPECIAL FACILITIES

CEE offers a variety of labs for students who are participating in research. Please see the information listed under facilities to read about our labs locations.

Computing Facilities

The Civil and Environmental Engineering Computer Lab (CEECL) is maintained as a state-of-the-art collaborative learning environment. The instructional lab provides excellent multimedia equipment for faculty to demonstrate and instruct students in the use of computing tools through the Department's curriculum. Faculty and students also have access to a variety of supercomputing facilities and data visualization capabilities through the computer resources of Virginia Tech.

Experimental Facilities

Experimental Facilities The Environmental Science and Engineering (ESEN) program occupies modern laboratories in Durham, Patton, Kelly, Steger and Hancock Halls. Laboratories and specialized experimental and analytical equipment support research programs related to areas such as water and wastewater treatment, hazardous and residuals waste management, water quality management, environmental chemistry, and air quality. Available equipment allows for the identification and quantification of most chemical and microbial environmental contaminants. The water resources engineering laboratories support basic and applied research activities in the areas of water, sediment, and pollutant movement in surface and groundwater sources. The Kelso Baker Environmental Hydraulics Laboratory houses two large (each 70 ft. long) tilting flumes, a medium length tilting fume, a 3-D laser Doppler velocimeter, a hot film anemometer, and numerous pieces of support instrumentation.

Occoquan Watershed Monitoring Laboratory (Manassas, Virginia)

The Occoquan Watershed Monitoring Laboratory (OWML), Manassas, is responsible for making determinations in a number of areas critical to the ongoing management of water quality in the Occoquan watershed, situated on the southwestern periphery of the Virginia suburbs of Washington, D.C. The basin encompasses six political subdivisions, including portions of four counties, and the entire land area of two independent cities. The lab is also the site of a National Science Foundation Growing Convergence Research center on reversing inland freshwater salinization (https://salt.cee.vt.edu/).

Potomac Aquifer Recharge Monitoring Laboratory (Hampton, Virginia)

The PARML, Hampton, is responsible for making determinations in a number of areas critical to the ongoing management of water quality in the Potomac aquifer, situated in the Hampton Roads area of Southeast Virginia. This work is in association with managed aquifer recharge associated with the $1 billion SWIFT (Sustainable Water Initiative For Tomorrow) project.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

iBT: overall (90.0), subsections (each has a minimum) (20.0)

MS ESEN degree may be taken either as coursework only or with the permission of the faculty may incorporate a project & report or a research thesis. See Departmental Manual:https://cee.vt.edu/content/dam/cee_vt_edu/files/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

FISHERIES AND WILDLIFE SCIENCES

Joel Snodgrass, Head

Emeriti Faculty: Steve McMullin; Brian Murphy; Richard Neves; Donald Orth; Dean Stauffer;

Professors: Kathleen Alexander; Paul Angermeier; James Fraser; Emmanuel Frimpong; Carola Haas; Eric Hallerman; William Hopkins; Yan Jiao; Sarah Karpanty; Marcella Kelly; Joel Snodgrass;

Associate Professors: Leandro Castello; Ashley Dayer; William Ford; James Parkhurst; Haldre Rogers;

Assistant Professors: Willandia Chaves Didier; Luis Escobar Quinonez; Francesco Ferretti; Elizabeth Hunter; Brett Jesmer; Holly Kindsvater;

Adjunct Faculty: C Dolloff;

Graduate Contact: makelly2@vt.edu

Graduate Site: https://fishwild.vt.edu/Graduate/prospective_students.html

The Department of Fish and Wildlife Conservation offers one of the leading programs of its type. The comprehensive curriculum covers fisheries and wildlife biology and ecology, habitat analysis, and human dimensions of natural resource science and management. Faculty specialties include endangered species management, cold water stream management, marine fisheries and conservation, conservation genetics, tropic ecology, recycling aquaculture systems, wildlife physiology and ecotoxicology, human-wildlife interactions (including disease transmission), habitat analysis and management, geographic information systems, human dimensions, policy and administration. M.S. programs stress preparation for professional careers in public agencies and private organizations with fisheries and wildlife responsibilities as well as pursuit of a PhD degree. Doctoral programs stress preparation for research and leadership positions in public agencies and for university faculty positions.

SPECIAL FACILITIES

The department maintains facilities in Cheatham and Latham Halls and the Integrated Life Sciences Biulding for laboratory analysis, small-scale aquatic experiments, small-animal holding, computer analysis, and geographic information systems. The latest computer technology is available. The Wild Animal Research Facilities (WARF) are located at the edge of the campus adjacent to an approximately 45 ac. woodlot that serves as a living-learning outdoor laboratory for research and teaching. The WARF consist of aquaculture laboratories that provide state-of-the-art facilities for aquaculture and endangered aquatic species propagation, the research aviary, and the black bear holding and research facilties.

Black Bear Research Facility

The Black Bear Research Facility provide housing and secondary and tertiary containment for adult and juvenile bears. The facility has associated investigator housing and laboratory space designed for physiological investigations.

Conservation Aquaculture Center

The Conservation Aquaculture Center is an approximately 5400 sq ft building designed for the culture and propagation of aquatic organisms. There are a range of tanks and other artificial aquatic habitat available from 10 gallon aquariums to artificial streams and large aquaculture tanks. The open and flexible space of this facility allows set-up of just about any aquaculture configuration or experimental design.

Integrated Life Sciences Building

Genetics and disease ecology laboratories are located in the Integrated Life Sciences Building in the Corporate Research Park at the south end of campus. The laboratories and accompanying shared facilities of ILSB provide modern genetic analyses and BSL Level 2 space.

Julian Cheatham Hall

Cheatham Hall houses the department's teaching and most of its research laboratories, computer labs, faculty and graduate student offices, and administration. Key research spaces include laboratories focusing on applied mammal and fish ecology, human dimensions of natural resources management, wildlife ecology, fish landscape ecology, wildlife behavioral ecology, threatened and endangered species, fluvial fishes, and wildlife habitat and population analysis.

Latham Hall

Dedicated in 2006, Latham Hall provides well-outfitted laboratory space, environmentally controlled chambers, a necropsy room, and a walk-in freezer. Laboratory and research spaces include: the Fish Ecology and Management Laboratory, human dimensions work space, the plant population and community ecology laboratory, and the animal behavior and movement laboratory.

Mussel Propagation Center

The Mussel Propagation Center is an open, reconfigurable aquaculture facility designed specifically for the propagation of North American freshwater mussels. An adjacent pond provides a food source for young mussels and the facility is equipped to house fish that function as hosts for the mussel larvae. An adjacent grow-out facility provides the production capacity to support reintroduction and augmentation programs for endangered mussel species.

Research Aviary

Our Research Aviary is a unique facility with 16 replicated aviary rooms and is located at our Wild Animal Research Facilities. Each room can house a small flock of songbirds or can house family groups of species. Other features include partial roofing of each room with an outer, mesh-enclosed area so the birds can experience daylight cycles and natural temperature changes, but remain sheltered from extreme weather.

Steger Hall

Steger Hall is part of the Frail Life Sciences Center and provide shared research facilities supporting the life sciences across departments and colleges. The conservation physiology and wildlife toxicology laboratory and the disease ecology and biogeography laboratory are located in Steger Hall.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

We offer M.S. and Ph.D. degrees in Fisheries and Wildlife Sciences. Students specialize in either Fisheries or Wildlife Science. Coursework is tailored to the interest and needs of the students in consultation with the student's graduate committee. All graduate students must conduct M.S. or Ph.D. research projects, in addition to course work chosen in consultation with an advisory committee. Research projects are designed in a student-written research working plan that is approved by the advisory committee. In almost all cases, students are funded on research contracts or teaching assistantships, both of which require substantial work outside of degree requirements. All students must deliver at least two seminars and write a semi-technical manuscript about their research. Doctoral students are required to complete a diagnostic assessment of their competencies in five areas of knowledge within the first semester in residence and must teach at least one semester, regardless of funding source. All students are expected to participate in the professional and collegial life of the department and its professional specialty by attending seminars and professional meetings, participating in student organizations, and serving on departmental and professional committees. We accept students only when a faculty member has agreed to serve as an advisor and provide support for a student's research work. Therefore, potential students are strongly encouraged to contact a faculty member in the department to discuss the availability of positions in that faculty members laboratory group before formally applying to the Graduate School at Virginia Tech. A listing of faculty and their research interests and projects can be found at our website. Updated lists of available positions are posted on the department's webpage as well. Please check the list of available positions on a regular basis to see if there are opportunities for the upcoming semesters that match your research interests. Please be aware that we receive some funding opportunities at the last minute. It will be worth checking this web site regularly. If you submit a formal application, you will be considered for any openings.

PhD Degree

Offered In (Blacksburg)

TOEFL

iBT: (80.0)

We offer M.S. and Ph.D. degrees in Fisheries and Wildlife Sciences. Students specialize in either Fisheries or Wildlife Science. Coursework is tailored to the interest and needs of the students in consultation with the student's graduate committee. Successful applicants to our program usually have grade point averages above 3.5/4.0 (over the last 60 semester hours). Discipline-related experience is always a plus.

Students with backgrounds in fisheries, wildlife, or natural resource management tend to be accepted at a higher rate than students with degrees in biology or environmental sciences. Although obviously there are many similarities between the fields, having a solid ecological background, an applied perspective, and background in policy and management is very helpful as you pursue an advanced degree in fisheries and wildlife. If you do not have a B.S. in a resource management field, and you have the opportunity to take courses in natural resource management or fisheries and wildlife management, you would increase your chances of acceptance. You also might gain a better feel for whether you would prefer enrolling in an ecology program or a fisheries and wildlife program. We accept students into the Ph.D. program only if they have completed an M.S. degree. We accept students only when a faculty member has financial resources to support stipend, tuition, and research expenses. Updated lists of available positions are posted on the department's webpage. Please check the list of available positions on a regular basis to see if there are opportunities for the upcoming semesters that match your research interests. Please be aware that we receive some funding opportunities at the last minute. It will be worth checking this web site regularly. You may want to check the list of faculty research and academic interests and correspond with a particular faculty member about likely openings in the next year or two. If you submit a formal application, you will be considered for any openings. All graduate students must conduct M.S. or Ph.D. research projects, in addition to course work chosen in consultation with an advisory committee. Research projects are designed in a student-written research working plan that is approved by the advisory committee. In almost all cases, students are funded on research contracts or teaching assistantships, both of which require substantial work outside of degree requirements. All students must deliver at least two seminars and write a semi-technical manuscript about their research. Doctoral students are required to complete a diagnostic assessment of their competencies in five areas of knowledge within the first semester in residence and must teach at least one semester, regardless of funding source. All students are expected to participate in the professional and collegial life of the department and its professional specialty by attending seminars and professional meetings, participating in student organizations, and serving on departmental and professional committees.

GRADUATE COURSES (FIW)

FIW 5004:

Graduate Seminar

Advanced exploration of special topics in fisheries and wildlife, through literature reviews, guest speakers, student/faculty presentations, and small group projects. Topics and format vary depending on interests of faculty and graduate students. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5114:

Fisheries and Wildlife Conservation Genetics

Population genetics of terrestrial and aquatic animals as applied to fisheries and wildlife management, endangered species management, and ecosystem protection. Discussion of genetic variability and analytic techniques, population genetic processes, and practical applications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5254:

Design&Analysis Field Study

Philosophy and principles of field study design and hypothesis testing. Habitat and population sampling design and analysis for terrestrial and aquatic systems. Integrating population and habitat data to develop resource selection functions. Principles of habitat modeling and community measures. Discussion and comparison of current trends in data analysis.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):   STAT 5605 OR STAT 5615 OR STAT 5674

Corequisite(s):

FIW 5314:

Vertebrate Population Ecology and Management

Wild animal population and evolutionary ecology. Historical and current research concerning theories of population growth, population regulation, spatially structured populations, evolution of life histories, and the scaling up of population concepts to community and ecosystem applications. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5414:

Endangered Species Management

History, philosophy, and practice of endangered species management with emphasis on management in the United States. Biology of extinction, rationale for preservation, endangered species legislation, status surveys, management goals, habitat protection, recovery plans.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIW 4414 OR FIW 4614 OR BIOL 4404

Corequisite(s):

FIW 5464G:

Advanced Human Dimensions of Fisheries and Wildlife

Values, attitudes and opinions of people towards fish and wildlife. Social, economic, legal and political aspects of fisheries and wildlife management. Roles of professionals and the public in fish and wildlife policy processes. Contemporary fish and wildlife policy issues. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5514:

Fish Population Dynamics and Modeling

Theory and application of fish population models for managing recreational and commercial fisheries. Estimation of basic fish population statistics (abundance, mortality, growth). Development and application of models for age-structured populations, bioenergetics, growth, stock-recruitment, yield, predation, and competition.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): FIW 4714

Corequisite(s):

FIW 5534G:

Advanced Wetland Ecology and Management

Introduction to the variety of wetland systems found in North American, with emphasis on eastern and mid-Atlantic wetland systems. Origin and processes of formation of wetlands, functions and values of wetlands, wetland delineation, wetland classification, regulatory processes affecting wetlands. Objective of management and techniques used to protect and/or manipulate wetland systems for wildlife and other human needs. Graduate Standing required.

Credit Hour(s): 0 TO 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5624G:

Advanced Marine Ecology

Marine organisms; biological, ecological, chemical and physical processes of marine ecosystems in open-sea, coastal, and benthic environments; research methods and models in marine ecosystem stimulation; fisheries in a dynamic ecosystem; human interference and conservation. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5714G:

Advanced Fisheries Management

History, theory, and practice of fisheries management. Emphasis on basic strategies used in effective management objectives. Synthesis of fish population dynamics and manipulation, habitat improvement, and human management to achieve objectives. Case studies of major fisheries. Pre-requisite: Graduate Standing required.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5764:

Systems Ecology and Conservation

Holistic approaches to understanding sustainable management and conservation of natural environments. Review of the Systems Ecology and Social-Ecological Systems school of thought. Focus on the use of energy principles and the resilience concept to articulate natural resource problems as integrated systems. Application of energy principles and resilience concept to real world examples. Discussion-based class. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5774:

Spatial Modeling of Species and Niches

Theory and practice of species distribution modeling, emphasizing statistical and ecological niche theory underpinnings; probability and matrix algebra for data manipulation and inference; scale, hierarchy, and network concepts for aquatic and terrestrial habitats; spatial dependence and autocorrelation in species and habitat data; sources and limitations of data for modeling species distributions; foundations, choice, and implementation of statistical models in appropriate software, emphasizing machine learning techniques; model assumptions, uncertainty, and model evaluation; model-based inference and null hypothesis testing in species distribution modeling; interpretation and conservation and management applications of models for binary data.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): STAT 5605 OR STAT 5615

Corequisite(s):

FIW 5814:

Stream Habitat Management

Application of stream ecology, fish biology, hydrology, and hydraulics to the protection, restoration, and enhancement of stream habitats and fauna. Major emphasis on stream habitat evaluation, regulated stream flow, biotic, integrity, and watershed management.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BIOL 4004

Corequisite(s):

FIW 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

FIW 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

FIW 6004:

Topics: Fisheries & Wildlife

Readings and discussion in a specific area of fisheries and wildlife conservation. Topic will vary and course may be taken for credit more than once. Background in fisheries or wildlife required. Variable credit course. Graduate standing required. I, II.

Credit Hour(s): 0 TO 12

Lecture Hour(s): 0 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 6114:

Applied Conservation Genetics

Use of analytical tools and software packages to characterize population genetics of terrestrial and aquatic animals for application in fisheries, wildlife, and endangered species management. Population genetic processes and theory, laboratory methods for screening molecular markers (mitochondrial and nuclear DNA markers), analysis of genetic data using various computer software programs, and interpretation of statistical results.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FIW 5114

Corequisite(s):

FIW 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FIW 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

FOOD SCIENCE AND TECHNOLOGY

Renee Boyer, Head

Professors: Renee Boyer; Joseph Eifert; Sean O'Keefe; Monica Ponder; Susan Sumner;

Associate Professors: Haibo Huang; David Kuhn; Amanda Stewart; Laura Strawn;

Assistant Professors: Yifan Cheng; Rachel Cheng; Dennis Cladis; Alexis Hamilton; Jacob Lahne; Yun Yin;

Research Scientists: Joell Eifert; Katheryn Parraga-Estrada; Harry Schonberger; Brian Wiersema;

Assistant Professor of Practice: Herbert Bruce;

General Contact: fstinfo@vt.edu

Graduate Site: https://www.fst.vt.edu/graduate.html

Food science and technology is a fusion of chemistry, microbiology and engineering. Our researchers explore innovation in the areas of creating new, healthful food products, and ensuring a safe and tasty food supply. Specific research emphases include: improving food nutrition, quality and flavor, developing novel functional food ingredients and products for promoting human health, packaging design and use of advanced technologies to identify and control food-borne disease causing organisms. Individual graduate programs are customized with the advisor to emphasize food safety/microbiology, biochemistry, food chemistry, or packaging. Student graduate programs are built around courses in microbiology, chemistry, biochemistry, biology, engineering, and statistics. This diverse curriculum prepares students for opportunities in industry, universities or government. Students who earn graduate degrees in Food Science and Technology at Virginia Tech have pursued careers with large food companies (Nestle, Campbell, Kroger, ConAgra, Hershey, etc.) and public health agencies (USDA, FDA, State Health and Agriculture Departments).

SPECIAL FACILITIES

The Department has research activity both on the Blacksburg campus and at the Seafood Agricultural Research and Extension Center (AREC) in Hampton, Virginia. Research and teaching facilities on the Blacksburg campus are located in the Food Science and Technology Building and in the Human & Agricultural Biosciences Building. These are further described below.

Food Science and Technology Building

The Department of Food Science and Technology facilities are primarily based in two buildings. The Food Science and Technology Building is a 34,000 square-foot building which includes a 68-seat classroom and a variety of analytical instrumentation, equipment, and research-scale pilot plant facilities including: Food Analysis Laboratories, Microbiology Laboratories, Packaging and Processing Pilot Plant, Research Winery and Enology Laboratory, Sensory Evaluation Laboratory, Analytical Support Laboratory, and administration offices.

Human and Agricultural Biosciences Building 1 (HABB1):

The Human and Agricultural Biosciences Building 1 houses research facilities for both the Food Science and Technology and the Biological Systems Engineering departments. The 93,860-square-foot building incorporates laboratory and support facilities, focusing on a wide range of microbiological and biochemical research. Researchers benefit from the expanded space which houses research programs on food safety, food packaging and processing, environmental quality analysis, bioenergy and biomaterials, systems biology, and nanotechnology, among other areas. This building includes the following: open workspaces and communal areas for faculty, students and industry to work collaboratively research laboratories with shared equipment and laboratory support spaces consolidated in the core of the building a 7,100 square foot food processing pilot plant. a 2,200 square foot food safety pilot plant certified for use with biosafety level 2 human pathogens sensory evaluation laboratory complete with sensory data collection software, observational cameras and multi-option booth lighting, individual panelist booths, prep kitchens, and group debriefing and discussion rooms. offices for researchers and work spaces for graduate students.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Computer: (213.0)

iBT: (90.0)

A Masters degree is expected for students applying to the doctoral program. In exceptional cases, some students with only a Bachelors degree may be considered for a direct Bachelors to PhD program. Students who do not have academic training equivalent to that required for a B.S. degree in Food Science and Technology at Virginia Tech will complete selected core courses before graduation. Students without a background in a science related field may be required to complete supplemental courses before being admitted to a regular student status. Any supplemental course work recommended by the Graduate Committee will be communicated to the applicant in a letter.

MSLFS Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

Computer: (213.0)

Students with a B.S. degree in Food Science (or other majors such as Chemistry, Biology, Food Engineering, Animal Science or Human Nutrition) are welcome to apply to our Masters degree program to earn a Master in Life Sciences (MSLFS) in Food Science and Technology. Students who do not have academic training equivalent to that required for a B.S. degree in Food Science and Technology at Virginia Tech will complete selected core courses before graduation. Students without a background in a science related field may be required to complete supplemental courses before being admitted to a regular student status. Any supplemental course work recommended by the Graduate Committee will be communicated to the applicant in a letter.

GRADUATE COURSES (FST)

FST 5004:

Graduate Seminar

Special topics, critical reviews, and discussions of current literature throughout a wide range of subject areas in food science and technology. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FST 5014:

Sensory Evaluation of Food

Principles of sensory evaluation including experimental methods, applications, and statistical analyses.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): STAT 2004 OR FST 4524)

Corequisite(s):

FST 5034:

Good Agricultural and Manufacturing Practices

Principles of food safety management for food producing and food processing environments. Emphasis on guidelines developed in Good Agricultural Practices for plant-based foods and Current Good Manufacturing Practices. Pre: Academic and/or professional background in food processing, quality assurance, fresh produce production, food product regulation, and/or food safety. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FST 5044:

Global Food Laws and Regulations

History of laws and regulations that affect the food processing industry and food consumers. Impact of legal and regulatory issues on food quality, safety, formulation, labeling, marketing, grading, product and process development, and international trade for the U.S. and other nations. Pre: Academic and/or professional background in food processing, quality assurance, and/or food safety.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FST 5054:

Professionalism in Food Scienc

Applied principles and skills in communication, research ethics and research project design for the food science profession. Pre: Graduate standing. P/F only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FST 5094 (CHEM 5094) (BMVS 5094):

Grant Writing and Ethics

A framework for writing clear, concise grant proposals in a team-oriented, multidisciplinary approach from concept development through submission to a funding agency. Potential ethical dilemmas that may arise in academic, industrial, or federal research settings will be discussed. PRE: Undergraduate courses in one of the following: organic chemistry (CHEM 2565/2566), cell & molecular biology (BIOL 2104), Concepts of Biochemistry (BCHM 2024), or equivalent. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FST 5404:

Food Packaging

Examines the role of food packaging in the preservation of foods in todays society. Food packaging materials will be discussed with emphasis on their interaction with food products. Specific applications of packaging materials to food groups will be discussed. Procedures to develop a new food package are incorporated in class activities.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FST 4405

Corequisite(s):

FST 5604:

Advances in Food Microbiology

Critical review of current topics in food microbiology. Foodborne pathogens, toxins, analytical methodology, food spoilage, inhibition and destruction of bacteria, standards, and fermentations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FST 4604, BCHM 5124

Corequisite(s):

FST 5614:

Food Safety and Security

Identification and prevention of food safety and security hazards that may result in intentional or unintentional contamination. Development and implementation of plans to enhance food safety and security in the processing, distribution, transportation, and retail segments of the food supply chain. Pre: Academic and/or professional background in food processing, quality assurance, and/or food safety. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FST 5624:

Applied Food Microbiology and Sanitation

Overview of the causes, transmission, and epidemiology of major environmental, food-, and water-borne diseases in the food industry. Detection, monitoring, and control of important environmental pathogens. Chemical, physical, and biological sanitation to control pathogens in food, water, and the environment. Pre: Academic and/or professional background in microbiology, food safety, or environmental health. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FST 5634:

Epidemiology of Food and Waterborne Diseases

Causes, transmission, and epidemiology of major environmental, food, and waterborne diseases. Outbreak and sporadic detection, surveillance, source tracking, and control of pathogens. Impact of food-borne outbreaks on economy and regulatory activities at the national and

global level. Risk assessment and strategies for prevention across diverse agricultural scales. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FST 5664:

Flavor Chemistry

Study of flavor compounds, their isolation, extraction, and flavor profiles. Examination of compounds that are used to produce commercial flavors from synthetic and natural sources. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): FST 4504, FST 4514
Corequisite(s):

FST 5904:

Project and Report

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Lecture, Online Research
Instruction Type(s): Research, Online Lecture, Online Research
Prerequisite(s):
Corequisite(s):

FST 5974:

Independent Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

FST 5984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FST 5994:

Research and Thesis

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

FST 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

FOREIGN LANGUAGES, CULTURES, AND LITERATURES

Ronda Watson, Chair

Professors: Alexander Dickow; Jessica Folkart; Aarnes Gudmestad; Corinne Noirot; Vinodh Venkatesh; Ronda Watson;

Associate Professors: Catalina Andrango-Walker; Elisabeth Austin; Maria Cana Jimenez; Medoune Gueye; Sharon Johnson; Gonzalo Montero Yavar; Patrick Ridge; Richard Shryock; Sarah Sierra;

Assistant Professors: Javiera Jaque Hidalgo;

Collegiate Assistant Professors: David Delgado Lopez; Andrea Hesp;

Graduate Contact: jfolkart@vt.edu

Graduate Site: https://liberalarts.vt.edu/departments-and-schools/department-of-modern-and-classical-languages-and-literatures.html

French and/or Spanish. On campus or online. Details at https://liberalarts.vt.edu/departments-and-schools/department-of-modern-and-classical-languages-and-literatures.html or contact psaville@vt.edu. The fully accredited Master of Arts in Foreign Languages, Cultures & Literatures at Virginia Tech is designed to meet the needs of students seeking academic and other professional careers in contexts that require intercultural competency as well as a specialized knowledge of Spanish and/or French. Key features: Internationally ranked research university Fully accredited Interdisciplinary approach to learning Coursework includes literature, cultural studies, cinema, visual culture, translation, linguistics and business Solid foundation in Hispanic, French, and Francophone cultures and literatures Acquisition and development of analytical abilities based on a range of critical approaches Preparation for working independently in a variety of settings Degree may be completed on campus or online Graduate teaching assistantships available at the Blacksburg campus. Financial aid available Our graduates pursue various career paths, including the following: Pre-K to 12 education Teaching at community colleges or universities NGO and development work Government agencies Doctoral education at top-ranked universities, such as Duke, Emory, University of North Carolina at Chapel Hill, Rutgers University, University of Minnesota, University of Virginia, University of Maryland, Washington University in St. Louis, Ohio State University See https://liberalarts.vt.edu/departments-and-schools/department-of-modern-and-classical-languages-and-literatures.html or contact us at psaville@vt.edu.

SPECIAL FACILITIES

The MA in French/Francophone, Hispanic, or Multilingual Studies may be completed at the Blacksburg campus, or online through the Virtual campus. Blacksburg students enjoy physical access to the full services of the university, including an extensive library, technology support, and the Graduate Life Center. Online students access the library electronically and by post. The university provides the specialized software necessary to attend classes online in real time, using the student's own computer, webcam, and headset. Full technical support is provided.

On campus or online

The MA in French/Francophone, Hispanic, or Multilingual Studies may be completed at the Blacksburg campus, or online through the Virtual campus. Blacksburg students enjoy physical access to the full services of the university, including an extensive library, technology support, and the Graduate Life Center. Online students access the library electronically and by post. The university provides the specialized software necessary to attend classes online in real time, using the student's own computer, webcam, and headset. Full technical support is provided.

DEGREES OFFERED

MA Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Students choose one of three tracks: French and Francophone Studies Hispanic Studies Multilingual Studies, combining French and Spanish Within each track, students will take a combination of required core courses and electives. In addition to coursework, students either write a thesis or take a comprehensive examination based on a reading list. Students enrolled full time usually complete all degree requirements within two academic years. Time to degree varies for part-time students. For details see https://liberalarts.vt.edu/departments-and-schools/department-of-modern-and-classical-languages-and-literatures.html or contact us at psaville@vt.edu.

FOREST PRODUCTS

Audrey Zink-Sharp, Associate Head
Ching-Hsun Huang, Head

Professors: Brian Bond; Urs Buehlmann; Robert Bush; Kevin Edgar; Charles Frazier; A Hammett; Ching-Hsun Huang; David Kline; Joseph Loferski; Robert Smith; Paul Winistorfer; Audrey Zink-Sharp;

Associate Professors: Daniel Hindman; Laszlo Horvath; Henry Quesada; Maren Roman;

Assistant Professors: Young Kim; Jennifer Russell;

General Contact: colleyp@vt.edu

The Department of Sustainable Biomaterials offers three graduate degrees: Master of Science (M.S.), Master of Forestry (M.F.) and Doctor of Philosophy (Ph.D.). The M.S. is a thesis-based degree, and the M.F. is a professional course-work-based non-thesis degree. Graduates at the M.S., M.F., and Ph.D. levels are successful in securing careers in public and private research organizations and universities, large sectors of the business world including forest products industries, packaging industries, bioenergy and energy engineering sector, and supply sector. Areas of degree specialization within our graduate program include green building design, life cycle assessment of renewable materials, circular economy, packaging systems & design, pallet and container design, plant anatomy, forest industry management & product marketing, lumber drying & processing, sustainable chemistry & plastics, wood composites, timber engineering, polymer science, and lean manufacturing.

SPECIAL FACILITIES

Excellent laboratory and classroom resources are available for education, research, and outreach in Blacksburg, Virginia and other locations across Virginia. Faculty, staff, and student researchers have access to research laboratories in several locations, principally Cheatham Hall on the main campus in Blacksburg and the Brooks Forest Products Center located approximately 1.5 miles from the main campus in the Virginia Tech Corporate Research Center. Cheatham Hall has space for research, education, and application short courses plus natural resource research laboratories and college-wide computing facilities. Our laboratories have capabilities for liquid and gas chromatographic separation of wood components, thermal analysis of cellulose materials, molecular weight determination, nuclear magnetic resonance, dynamic mechanical analysis, FT-IR and UV-VIS spectroscopy, contact angle analysis, light and electron microscopic study of structure and properties, and wide-angle X-ray diffraction for crystallinity and microfibril angle analysis. The Brooks Center has classrooms, offices, and laboratories for the manufacture of pressed panels, several engineering testing machines, wood and metal working shops, pallet and container research facilities, packaging research equipment, and other wood and fiber-based composite testing instrumentation.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

All program degree requirements and supplemental information about graduate education in our department is summarized in our annually updated Graduate Student Policy and Procedures manual, available online on our department website. This manual describes all required coursework, graduation and other requirements, and activities associated with graduate education in our department. The department offers three degrees: Master of Forestry (M.F.), Master of Science (M.S.) in Forestry and Forest Products, and Doctor of Philosophy (Ph.D.) in Forestry and Forest Products. The M.S. and Ph.D. degrees require students to prepare a thesis or dissertation, and considerable time spent working for these degrees is devoted to research. The M.F. degree is a professional, non-research, non-thesis degree for those who wish to expand their post-baccalaureate education.Master of Forestry The M.F. is a non-thesis degree intended to serve the needs of those who have a prior sustainable biomaterials degree and who wish to enhance their knowledge and skills, or those who have no previous degree in sustainable biomaterials.In addition to formal course work at the graduate and senior undergraduate levels that is commensurate with the objectives of the student's degree program, a substantive paper worth three to six hours of academic credit is required. A minimum credit hours in formal course work, inclusive of hours credited towards the degree paper, must be passed with a minimum GPA of 3.0 for courses in the program of study. The M.F. student must pass a comprehensive oral examination covering her/his course work and the degree paper. All Graduate School requirements apply to the nature and timing of the candidate's final examination. Master of Science The M.S. is a research-based degree. Students work closely with a faculty advisor and graduate committee on original research. Advanced coursework is expected in the areas of expertise required to complete the research project. Students complete a thesis and are expected to publish their research results in peer-reviewed scientific journals at the completion of their degree. Graduates are prepared to continue their professional careers or undertake further study through a Ph.D. program. All Graduate School requirements apply regarding the number of credit hours and level of courses required on a student's Plan of Study. M.S. students must complete a research working plan by the end of the second academic semester. Guidelines for the preparation and submission of the working plan are listed in the College of Natural Resources & Environment (CNRE) graduate program procedures. M.S. students must pass a final exam. The examination will be a defense of the thesis and an assessment of the student's understanding of appropriate related subjects. Doctor of Philosophy Each Ph.D. student must complete a minimum of 90 credit hours of graduate study and a dissertation. The Plan of Study must meet minimum Graduate School requirements; in addition, a student's advisory committee may add specific requirements needed for an individual student's academic development. Ph.D. students must complete a research working plan by the end of the third academic semester. Guidelines for the preparation and submission of the working plan are listed in the College of Natural Resources & Environment (CNRE) graduate program procedures. A preliminary exam, oral and/or written, is conducted by the student's advisory committee. It is comprehensive in nature and intended to test a student's ability to integrate, synthesize, and apply concepts, facts, and techniques in solving new and complex problems associated with sustainable biomaterials. The student may be tested on any aspect of sustainable biomaterials science, the philosophy of science, and research methodology. The final exam is primarily a defense of the dissertation, but other areas of science may be included. Ph.D. students are expected to publish their research results in peer-reviewed scientific journals at the completion of their degree.

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

All program degree requirements and supplemental information about graduate education in our department is summarized in our annually updated Graduate Student Policy and Procedures manual, available online on our department website. This manual describes all required coursework, requirements and activities associated with graduate education in our department. The department offers three degrees: Master of Forestry (M.F.), Master of Science (M.S.) in Forestry and Forest Products, and Doctor of Philosophy (Ph.D.) in Forestry and Forest Products. The M.S. and Ph.D. degrees require students to prepare a thesis or dissertation, and considerable time spent working for these degrees is devoted to research. The M.F. degree is a professional, non-research degree for those who wish to expand their post-baccalaureate education.Master of Forestry The M.F. is a non-thesis degree intended to serve the needs of those who have a prior sustainable biomaterials degree and who wish to enhance their knowledge and skills, or those who have no previous degree in sustainable biomaterials.In addition to formal course work at the graduate and senior undergraduate levels that is commensurate with the objectives of the student's degree program, a substantive paper worth three to six hours of academic credit is required. A minimum of 33 credit hours in formal course work, inclusive of hours credited towards the degree paper, must be passed with a minimum GPA of 3.0 for courses in the program of study. The M.F. student must pass a comprehensive oral examination covering his/her course work and the degree paper. All Graduate School requirements apply to the nature and timing of the candidate's final examination. Master of Science The M.S. is a research-based degree. Students work closely with a faculty advisor and graduate committee on original research. Advanced coursework is expected in the areas of expertise required to complete the research project. Students complete a thesis and are expected to publish their research results in peer-reviewed scientific journals at the completion of their degree. Graduates are prepared to continue their professional careers or undertake further study through a Ph.D. program. All Graduate School requirements apply regarding the number of credit hours and level of courses required on a student's Plan of Study. M.S. students must complete a research working plan by the end of the second academic semester. Guidelines for the preparation and submission of the working plan are listed in the College of Natural Resources & Environment (CNRE) graduate program procedures. M.S. students must pass a final exam. The examination will be a defense of the thesis and an assessment of the student's understanding of appropriate related subjects. Doctor of Philosophy Each Ph.D. student must complete a minimum of 90 credit hours of graduate study and a dissertation. The Plan of Study must meet minimum Graduate School requirements; in addition, a student's advisory committee may add specific requirements needed for an individual student's academic development. Ph.D. students must complete a research working plan by the end of the third academic semester. Guidelines for the preparation and submission of the working plan are listed in the College of Natural Resources & Environment (CNRE) graduate program procedures. A preliminary exam, oral and/or written, is conducted by the student's advisory committee. It is comprehensive in nature and intended to test a student's ability to integrate, synthesize, and apply concepts, facts, and techniques in solving new and complex problems associated with sustainable biomaterials. The student may be tested on any aspect of sustainable biomaterials science, the philosophy of science, and research methodology. The final exam is primarily a defense of the dissertation, but other areas of science may be included. Ph.D. students are expected to publish their research results in peer-reviewed scientific journals at the completion of their degree.

MF Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

All program degree requirements and supplemental information about graduate education in our department is summarized in our annually updated Graduate Student Policy and Procedures manual, available online on our department website. This manual describes all required coursework, requirements and activities associated with graduate education in our department. The department offers three degrees: Master of Forestry (M.F.), Master of Science (M.S.) in Forestry and Forest Products, and Doctor of Philosophy (Ph.D.) in Forestry and Forest Products. The M.S. and Ph.D. degrees require students to prepare a thesis or dissertation, and considerable time spent working for these degrees is devoted to research. The M.F. degree is a professional, non-research degree for those who wish to expand their post-baccalaureate education.Master of Forestry The M.F. is a non-thesis degree intended to serve the needs of those who have a prior sustainable biomaterials degree and who wish to enhance their knowledge and skills, or those who have no previous degree in sustainable biomaterials.In addition to formal course work at the graduate and senior undergraduate levels that is commensurate with the objectives of the student's degree program, a substantive paper worth three to six hours of academic credit is required. A minimum of 33 credit hours in formal course work, inclusive of hours credited towards the degree paper, must be passed with a minimum GPA of 3.0 for courses in the program of study. The M.F. student must pass a comprehensive oral examination covering his/her course work and the degree paper. All Graduate School requirements apply to the nature and timing of the candidate's final examination. Master of Science The M.S. is a research-based degree. Students work closely with a faculty advisor and graduate committee on original research. Advanced coursework is expected in the areas of expertise required to complete the research project. Students complete a thesis and are expected to publish their research results in peer-reviewed scientific journals at the completion of their degree. Graduates are prepared to continue their professional careers or undertake further study through a Ph.D. program. All Graduate School requirements apply regarding the number of credit hours and level of courses required on a student's Plan of Study. M.S. students must complete a research working plan by the end of the second academic semester. Guidelines for the preparation and submission of the working plan are listed in the College of Natural Resources & Environment (CNRE) graduate program procedures. M.S. students must pass a final exam. The examination will be a defense of the thesis and an assessment of the student's understanding of appropriate related subjects. Doctor of Philosophy Each Ph.D. student must complete a minimum of 90 credit hours of graduate study and a dissertation. The Plan of Study must meet minimum Graduate School requirements; in addition, a student's advisory committee may add specific requirements needed for an individual student's academic development. Ph.D. students must complete a research working plan by the end of the third academic semester. Guidelines for the preparation and submission of the working plan are listed in the College of Natural Resources & Environment (CNRE) graduate program procedures. A preliminary exam, oral and/or written, is conducted by the student's advisory committee. It is comprehensive in nature and intended to test a student's ability to integrate, synthesize, and apply concepts, facts, and techniques in solving new and complex problems associated with sustainable biomaterials. The student may be tested on any aspect of sustainable biomaterials science, the philosophy of science, and research methodology. The final exam is primarily a defense of the dissertation, but other areas of science may be included. Ph.D. students are expected to publish their research results in peer-reviewed scientific journals at the completion of their degree.

GRADUATE COURSES (SBIO)

SBIO 5004:

Forest Products Graduate Seminar

Gives graduate students experience in presenting results or reviews of forest products and wood science topics. The course also provides opportunities for students to learn about recent developments in forest products from invited speakers.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

SBIO 5114:

Professional Skills for Sustainable Biomaterials Graduate Students

Skills for success in graduate programs and professional employment. Literature reviews, ethics, professional presentations, laboratory safety, technical writing, reviewing scholarly works, publishing research results, research misconduct. Pass/Fail Only. Pre: Graduate Standing.

Credit Hour(s): 2

Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

SBIO 5124:
Wood Material Science
Advanced and comprehensive treatment of wood material science including wood anatomy and formation, mechanical and physical properties, and wood polymer science.
Credit Hour(s): 4
Lecture Hour(s): 3
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

SBIO 5224:
Quantitative Wood Anatomy
Formation, composition, and arrangement of the anatomical elements of tree stem wood. Preparation methods and examination of wood and wood fiber with light and scanning electron microscopy and select methods for quantitive characterization of wood anatomical structure. Pre-requisite: Graduate Standing required
Credit Hour(s): 2
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

SBIO 5324:
Timber Engineering
Rationale behind current design procedures for wood structures and components. Advanced topics such as reliability-based design, fracture mechanics, cumulative damage theory, and the effects of a changing resource and technology base.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

SBIO 5424G (CHEM 5424G):
Adv Polysaccharide Chemistry
Structure, properties, and applications of natural polysaccharides. Natural sources and methods of isolation. Synthetic chemistry and important polysaccharide derivatives Relation of structure and properties to performance in critical applications including pharmaceuticals, coatings, plastics, rheology control, and films. Conversion by chemical and biochemical methods of polysaccharide biomass to fuels and materials. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

SBIO 5614:
Forest Products Marketing and Management Strategies
Examination of forest products markets, industry structure, distribution channels, and strategic management trends. Case studies demonstrate the impact of these factors on decision-making in the forest products industry.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): SBIO 4614 OR FREC 3424
Corequisite(s):

SBIO 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

SBIO 5954:
Study Abroad
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

SBIO 5974:
Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

SBIO 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

SBIO 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

SBIO 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

FORESTRY

Bradley Sullivan, Head

Professors: Gregory Amacher; Wallace Aust; Carolyn Copenheaver; Jason Holliday; Robert Hull; John McGee; Kevin McGuire; John Munsell; Stephen Schoenholtz; John Seiler; Marc Stern; Brian Strahm; Bradley Sullivan; Valerie Thomas; Randolph Wynne;

Associate Professors: Scott Barrett; Amy Brunner; Kelly Cobourn; Daniel McLaughlin; Philip Radtke; Michael Sorice; Robert Thomas; Phillip Wiseman;

Assistant Professors: David Carter; Thomas Coates; John Gannon; Patrick Green; Stella Schons Do Valle;

Julian N. Cheatham Professor of Forestry: Gregory Amacher;

Honorable Garland Gray Professor: Wallace Aust;

Shelton H. Short, Jr., Professor of Forestry: John Seiler;

Adjunct Faculty: Jeffrey Marion;

Graduate Contact: skuhar@vt.edu

Website: http://www.frec.vt.edu

The Department of Forest Resources and Environmental Conservation at Virginia Tech is one of the top programs in the science and management of natural resources in the United States. Graduate training in our department offers a unique opportunity to explore diverse natural resource issues from multiple disciplinary and interdisciplinary perspectives. From the foundational science that underpins our understanding of the world, to its application for multiple management objectives, we seek to discover new knowledge and technology to address societal challenges from local to global scales.

SPECIAL FACILITIES

Cheatham Hall (JCH): The College of Natural Resources and Environment administrative and advising offices are located in Cheatham Hall, which houses the Departments of Forest Resources and Environmental Conservation, Sustainable Biomaterials, Fish and Wildlife Conservation, and the Virginia Water Resources Research Center. Teaching classrooms, laboratories, and faculty and graduate offices are located in Cheatham Hall. Latham Hall: The Latham Agriculture and Natural Resources Building houses several faculty offices and laboratories in the Department of Forest Resources and Environmental Conservation. For information on analytical lab spaces and equipment in Latham, please contact Dave Mitchem at dmitchem@vt.edu. Center for Environmental Analytics and Remote Sensing (CEARS): CEARS is located in 217 Cheatham Hall. The laboratory houses 22 networked precision workstations, a high-end large-format printer, and field equipment to support in situ measurements. The Center also provides access to an extensive archive of Landsat and MODIS scenes as well as software for image processing, compiling, statistical analysis, and GIS. For access to the CEARS Lab, please see Les Fuller in 216 Cheatham to request and complete an account request form. Reynolds Homestead Forest Resources Research Center: The Reynolds Center is a 710-acre research and education center located in the Virginia Piedmont 70 miles southeast of Blacksburg in Critz, Virginia. The Center houses laboratory space, greenhouses, and a continuing education center that support research and education in the Department of Forest Resources and Environmental Conservation. Fishburn School Forest: The Fishburn is a 1,353-acre demonstration forest, located 10 minutes from campus. The forest is comprised of Appalachian hardwood and mixed pine-hardwood and supports field research, teaching, and demonstration projects in the Ridge and Valley physiographic region. Equipment Room: The Department maintains a supply of field equipment for use in teaching and research. For checkout procedures and access, contact Tal Roberts at talr@vt.edu or Kathie Hollandsworth in 228 Cheatham. Sample Preparation and Storage Facilities: The Department maintains multiple facilities for equipment storage and processing and storage of field samples. For use procedures and access, contact Dave Mitchem at dmitchem@vt.edu. Forest Harvesting Laboratory: The 2,400-square foot Forest Harvesting Lab is located in Blacksburg adjacent to the Virginia Tech campus. The lab has a fully equipped machine shop used to fabricate new machine designs and support equipment used in field research in the Department. For procedures and access, contact Tal

Roberts at talr@vt.edu.

FREC Facilities

Cheatham Hall (JCH): The College of Natural Resources and Environment administrative and advising offices are located in Cheatham Hall, which houses the Departments of Forest Resources and Environmental Conservation, Sustainable Biomaterials, Fish and Wildlife Conservation, and the Virginia Water Resources Research Center. Teaching classrooms, laboratories, and faculty and graduate offices are located in Cheatham Hall. Latham Hall: The Latham Agriculture and Natural Resources Building houses several faculty offices and laboratories in the Department of Forest Resources and Environmental Conservation. For information on analytical lab spaces and equipment in Latham, please contact Dave Mitchem at dmitchem@vt.edu. Center for Environmental Analytics and Remote Sensing (CEARS): CEARS is located in 217 Cheatham Hall. The laboratory houses 22 networked precision workstations, a high-end large-format printer, and field equipment to support in situ measurements. The Center also provides access to an extensive archive of Landsat and MODIS scenes as well as software for image processing, compiling, statistical analysis, and GIS. For access to the CEARS Lab, please see Les Fuller in 216 Cheatham to request and complete an account request form. Reynolds Homestead Forest Resources Research Center: The Reynolds Center is a 710-acre research and education center located in the Virginia Piedmont 70 miles southeast of Blacksburg in Critz, Virginia. The Center houses laboratory space, greenhouses, and a continuing education center that support research and education in the Department of Forest Resources and Environmental Conservation. Fishburn School Forest: The Fishburn is a 1,353-acre demonstration forest, located 10 minutes from campus. The forest is comprised of Appalachian hardwood and mixed pine-hardwood and supports field research, teaching, and demonstration projects in the Ridge and Valley physiographic region. Equipment Room: The Department maintains a supply of field equipment for use in teaching and research. For checkout procedures and access, contact Tal Roberts at talr@vt.edu or Kathie Hollandsworth in 228 Cheatham. Sample Preparation and Storage Facilities: The Department maintains multiple facilities for equipment storage and processing and storage of field samples. For use procedures and access, contact Dave Mitchem at dmitchem@vt.edu. Forest Harvesting Laboratory: The 2,400-square foot Forest Harvesting Lab is located in Blacksburg adjacent to the Virginia Tech campus. The lab has a fully equipped machine shop used to fabricate new machine designs and support equipment used in field research in the Department. For procedures and access, contact Tal Roberts at talr@vt.edu.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

GRE

General: Verbal, Quantitative, Analytical

Master of Science (M.S.) The M.S. is a research-based degree designed to prepare students for additional graduate study or a career in science. Candidates must prepare a thesis for which credit will be earned towards completion of the degree.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

GRE

General: Verbal, Quantitative, Analytical

Doctor of Philosophy (Ph.D.) The Ph.D. is a research-based degree designed as a terminal degree to prepare students for a career in teaching and/or research. Candidates must prepare a dissertation for which credit will be earned towards completion of the degree.

MF Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

GRE

General: Verbal, Quantitative, Analytical

Master of Forestry (M.F.) The M.F. is a non-thesis, professional degree designed primarily for those seeking career advancement. Minimum residency requirement is two semesters. Candidates must prepare a paper for which credit will be earned towards completion of the degree.

GRADUATE COURSES (FREC)

FREC 5004:

Graduate Seminar

Special topics, critical reviews, and discussions of pertinent literature throughout a wide range of subject areas in forestry. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5014:

Graduate Student Success in Forest Resources and Environmental Conservation

Practices and perspectives for graduate student success in Forest Resources and Environmental Conservation. Identification of plagiarism and other violations of Virginia Tech Honor Code. Proper use of professional conventions for citations, accurate reporting, and research and scholarship. Ethical standards in teaching, mentoring, and professional activities. Addressing ethical misconduct. Apply Virginia Tech Principles of Community to value human diversity and inclusion. Impact of personal actions and words on self, others, and community related to privilege bias, power, prejudice, discrimination, and identity. Avenues of redress in response to violations of the Virginia Tech Principles of Community. Focus on one's own implicit or unconscious bias. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5024:

Coupling Social and Ecological Systems

Human-environment relationships in research. Current paradigms in environmental conservation. Methods and approaches to conducting coupled human-environment research and management. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5024G:

Advanced Forest Resources Management and Business

Forest management and business principles, theory, and methods to support sound decision-making in forestry: from the level of the forest to the business organization as a whole. Capital budgeting methods to prescribe forest harvest schedules and perform forest finance analyses. Forest industry structure, trends, and future performance. Strategic management frameworks (e.g., SWOT (Strengths, Weaknesses, Opportunities, and Threats), PIE (Potential, Importance, and Ease) and Porter's Five Focus analyses) and the influence of public policy and regulation on forest business strategy. Ethics, sustainability and corporate social responsibility applied to real forest business problems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5104 (GEOG 5104):

Seminar in Remote Sensing & Geographic InformationSystems

Interdisciplinary seminar devoted to current research in the fields of remote sensing, Geographic Information Systems, and related topics. Seminars, workshops, and presentations conducted by students, faculty, and visitors. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5114G:

Advanced Information Technologies for Natural Resource Management

Course will introduce students to the theory and applications of database management systems (DBMS) and geographic information systems (GIS). Uses, challenges, and limitations of these technologies in natural resource management application will be discussed.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): FREC 2214 (UG) OR GEOG 2314 (UG)

Corequisite(s):

FREC 5134:

Environmental Conflict Management

Seminar-styled course will develop and explore theories and practical approaches to understanding and managing modern environmental conflicts, with an emphasis on the processes and structures unique to the United States. Causes, controls, and potential remedies for managing the intense conflicts routinely associated with natural resource management and environmental regulation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FREC 5144 (CSES 5144):
Watershed Hydrology
Physical concepts of hydrological processes that affect age, origin, cycling, and flowpaths of water within watersheds. Analysis of current and historical research methods. Hydrological science as an interdisciplinary topic. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FREC 5154 (GEOG 5154):
Hyperspectral Remote Sensing
Theory of spectroscopy and spectrometry from portable spectroradiometers to airborne and spaceborne hyperspectral sensors as relevant to natural resource applications, including vegetation species identification and vegetative health, soil and peat properties, mineral and geothermal characteristics, and water applications. Practical investigation of research tools and techniques used to analyze hyperspectral data. Prerequisite: Graduate Standing Required
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FREC 5164:
Population Genomics
Contemporary sequencing, genotyping, and analytical approaches to understanding the causes and consequences of genomic variation that impinges on fitness, productivity, and health of natural and managed populations of plants and animals. Neutral population and evolutionary genetic processes, methods to identify the molecular targets of natural selection, genetic variation relevant to fitness- related traits, software tools relevant to genomic data analysis in a population genetic context. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FREC 5224:
Forest Biometry
Theory and practice involved in the measurement and modeling of the growth and yield of forest trees and stands
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): FREC 3215, FREC 3216, STAT 5606, STAT 5616
Corequisite(s):

FREC 5244G (WATR 5244G):
Advanced Hydroinformatics
Analysis and examination of hydrologic data using basic statistics and computer programming. Calculation and interpretation of flow frequency and duration, hydrologic analysis of geospatial digital terrain data, and implementation and analysis of simple hydrologic models. Advanced methods of temporal and spatial hydrologic data visualization using computer programming. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FREC 5254:
Remote Sensing of Natural Resources
Philosophy and rationale of remote sensing as a part of the resource management process; comparisons of analogic and digital sensors; sensor selection and proper use; accuracy assessment; signature development; and identification of factors which affect the quality of remotely sensed information.
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture, Online Lecture
Instruction Type(s): Lab, Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

FREC 5334:
Plant Water Relations

Properties and status of water in the plant and thermodynamics in relation to water and solute movement; measuring water deficits and drought tolerance; and transpiration and stomatal action.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5354:

Soil Science and Biogeochemistry

Foundations of soil science and biogeochemistry. Concepts in soil and landscape evolution; elemental cycling; soil-plant-microbe interactions; soil sampling and analysis; and relationships among physical, chemical, and biological properties and processes. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5374:

Advanced Forest Ecology

Advanced topics in forest ecology, including: forest populations, forest community dynamics, forest community structure and analysis, forest productivity on a global scale, ecology of forest landscapes, spatial heterogeneity, and hierarchy issues in ecology.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): FREC 3314, MATH 2016, STAT 5606, STAT 5616

Corequisite(s):

FREC 5374G:

Advanced Forested Wetlands

Classifications, jurisdictional delineation, and management options of forested wetlands. Relationship of hydrology, soils, and vegetation to ecosystem processes, societal values, and management with regard to environmental and legal considerations and best management practices. Emphasis is on forested wetlands in the southern U.S. but national and international wetlands are included. Data analysis, interpretations, and report for field trips are required for graduate credit. COURSE FEE: $113. Pre: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5416:

Advanced Forest Resource Management and Economics

5415: Application of microeconomics to solving forest resource problems. Emphasis on forest products demand and supply analysis, forest products marketing, forest capital theory, and interregional and international trade in forest products. 5416: Impacts of economic and physical variables upon forest appraisal and management decisions. Valuation of nonmarket goods and economics of multiple-use. Application of operations research tools in evaluating forest management alternatives in public and private forest planning. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FREC 3414, FREC 4424

Corequisite(s):

FREC 5454G:

Advanced Urban Community Forestry

Ecological, socioeconomic, and technical aspects of planning, managing, and conserving urban forests. Historical, contemporary, and global context of urban forestry. Contributions of trees and associated greenspaces to urban sustainability and community well-being. Methods of urban forest assessment and valuation. Roles of government, private industry, and community stakeholders in shaping urban forests. Extensive experiential learning with field techniques and technology. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5464:

Social Science Research Methods in Natural Resources

Social science research design and methods for students studying natural resource management. Addresses the unique and interdisciplinary nature of social science research related to complex natural resource problems. Guides students through the development of research questions into detailed research proposals that address human dimensions of natural resource management. Students own research topics will provide examples for in-class discussion of research design. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5464G:

Advanced Water Resource Policy and Economics

Economic theory and methods to explain water use decisions. Efficiency, equity, and ethical considerations in U.S. water policy. Analysis of water markets, climate change, and environmental flows from diverse stakeholder perspectives. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5474:

Adv Stud in Urban For Ecosys

The nature and dynamics of urban ecosystems with emphasis on the role of urban forests. Examines the interactions of urban forests with the built environment at multiple scales and from multiple disciplinary perspectives. Management influence on ecosystem processes and approaches to estimating urban forest ecosystem services from urban cores to pre-urban development. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5544 (AAEC 5544) (GEOG 5544):

Remote Sensing in the Social Sciences

Principles on the use of remotely sensed (satellite) data in social science research, with key applications in environment, agriculture, and economic development. Basic scripting techniques to extract, visualize, and analyze satellite remote sensing data across the electromagnetic spectrum with cloud-based computing platforms. Development of social science research proposals using remotely sensed data and based on review of relevant seminal and current research articles. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5714G:

Advanced Harvesting Systems Evaluation

Advanced principles and techniques for evaluating harvesting machines and systems design, application, productivity, and financial performance. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5784G:

Advanced Wetland Hyrdology and Biogeochemistry

Water flows creating wetland hydrologic regime. Hydrologic controls on wetland processes. Linkages between hydrology and biogeochemical cycles. Carbon, nitrogen, phosphorus, and other element cycles within and across wetland boundaries. Field methods to assess hydrologic regime and biogeochemical cycles. Ecosystems services from hydrologic and biogeochemical processes. Applications of wetland hydrology and biogeochemistry in wetland restoration, delineation, and creation. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5884:

Topics in Forest Resources and Environmental Conservation

Topics in forest resources and environmental conservation. Evaluation of literature and/or a critical appraisal of methods/approaches of analysis related to contemporary issues. May be repeated with different content for a maximum of 16 credits. Pre: Graduate standing.

Credit Hour(s): 1 TO 4

Lecture Hour(s): 1 TO 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

FREC 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

FREC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

FREC 6214 (GEOG 6214):

Forestry Lidar Applications

Theoretical underpinning of established and emerging research using light detection and ranging (lidar) technology for forestry applications including detailed terrain mapping and digital elevation models, canopy height modeling, prediction of forest biophysical parameters, forest physiology and the canopy light regime, watershed mapping and stream modeling, ecological modeling, landscape classifications, and wildlife habitat. Advanced research tools and techniques used to analyze lidar data for different applications. Graduate standing required.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): (FREC 5254 OR FOR 5254), (FREC 5264 OR FOR 5264), GEOG 5034

Corequisite(s):

FREC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

FREC 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GENETICS, BIOINFORMATICS, AND COMPUTATIONAL BIOLOGY

Liwu Li, Program Director

Professors: Daniela Cimini; Glenda Gillaspy; Lenwood Heath; Jason Holliday; Maria Lazar; Biswarup Mukhopadhyay; T Murali; Christopher North; Alexey Onufriev; Mohammad Saghai-Maroof; Adrian Sandu; Clifford Shaffer; Igor Sharakhov; Edward Smith; Zhijian Tu; Boris Vinatzer; Layne Watson; Liqing Zhang; Jinsong Zhu;

Associate Professors: Bahareh Behkam; Young Cao; Silke Hauf; Richard Helm; John Jelesko; Song Li; Michelle Olsen; Amy Pruden-Bagchi; Florian Schubot; Ryan Senger; Hehuang Xie;

Assistant Professors: Rana Ashkar; Bastiaan Bargmann; Jing Chen; Rebecca Cockrum; Kate Langwig; Gota Morota; Sujith Vijayan; Mark Williams;

Research Assistant Professors: Fernando Biase;

Collegiate Assistant Professors: Anne Brown;

Assistant Professor of Practice: Cassidy Rist;

Graduate Contact: dennie@vt.edu

GBCB Home Page: https://gbcb.graduateschool.vt.edu/

The research paradigm exemplified by the Human Genome Project requires an academic training paradigm that creates team-oriented researchers who may be specialists in one area but who are literate in several other disciplines. For example, researchers with expertise in the mathematical, statistical, or computer sciences also require sufficient knowledge in biology to understand the questions in order to develop appropriate analytical methods and computer tools. Similarly, life scientists need sufficient grounding in mathematics, statistics and computer science to be educated users of these quantitative methods and tools, and to conceptualize new tools. Research and training environments that produce such a combination of skills are not commonly found in academia. Our program is designed to provide that training environment in genetics/genomics, bioinformatics, and computational biology. Our program will allow Ph.D. students to conduct original research in the areas of genetics, bioinformatics, and computational biology. This training will enable graduates of the program to pursue careers in academia, government, or the private sector. This will be achieved through a combination of discipline-specific and cross-disciplinary course work, as well as a multidisciplinary research environment maintained by program faculty and distinguished by a high level of collaboration between disciplines. The scientific and training focus of the program is on three interdependent areas which have emerged as significant in the post-genomic era: experimental approaches and technologies for addressing complex biological questions, methods for collection, management and analysis of large biological data sets, and data-based modeling of biological systems.

SPECIAL FACILITIES

These are some of the many buildings housing several labs that GBCB students and faculty work in: Fralin Life Sciences Institute (FLSI), Torgersen Hall, Derring Hall, Life Sciences Building I (LSI), Latham Hall, McBryde Hall, Fralin Hall, Engel Hall, Seitz Hall, Price Hall, Steger Hall, and many others across campus due to the breadth of our program.

Genetics, Bioinformatics, and Computational Biology

Several facilities are shared across campus due to the breadth of our program: Some of the buildings are Derring Hall, Latham Hall, Life Sciences 1 Building, McBryde Hall, Price Hall, Steger Hall and Torgersen Hall.

Genetics, Bioinformatics, and Computational Biology

Several facilities are shared across campus due to the breadth of our program. Some of the buildings are Torgersen Hall, McBryde Hall, VBI, Latham Hall, Derring Hall, Life Sciences 1 Building, Price Hall, etc.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

IELTS: (6.5)

GRE

General Test: Verbal (300.0), Quantitative (700.0), Analytical (3.0)

GBCB is a Ph.D. program only, it does not offer a Master's degree. The Ph.D. degree requires a minimum of 90 total credit hours beyond the baccalaureate. Additionally, a dissertation must be written and defended before a 4-person committee. The Ph.D. plan of study is due by the end of the fourth semester of study. The distribution of the 90 required hours can be: 30-63 credit hours of research (7994 level only)27-60 graded coursework (graduate level)For the purposes of this program and to insure that students have a breadth of exposure, four specialty tracks are defined: LIFE SCIENCES, COMPUTER SCIENCE, STATISTICS, and MATHEMATICSA student will select one of the specialty tracks as his/her primary track, which will typically be consistent with the student's undergraduate training. The other tracks will be denoted as secondary tracks. Requirements will differ among the specialty tracks, with some requiring more coursework, and with correspondingly fewer credit hours of Research and Dissertation. In addition, a core curriculum that is common to all students has been defined:GBCB 5874 Problem Solving(3 credits) STS 5444 Issues in Bioethics(3 credits)GBCB 5004 Seminar (4 credits)A sample plan of study will include the following:Primary Track: At least 9 credit hours must be from the primary track. For students whose primary track is the Life Science track, 3 of these credit hrs must be a genomics course. Several genomics courses are offered through different departments. (e.g., CSES/GBCB 5844 - Plant Genomics) Secondary Tracks: At least 12 credit hours must be taken, with the courses coming from at least two of the three secondary tracks. For students whose primary track is not in Life Sciences, at least 6 of these credit hrs must be in the life sciences track. Students in the Statistics primary track must take a genomics course. General Electives: Choice of at least 6 credit hrs of electives Research & Dissertation: Sufficient to accumulate 90 total credit hours, minimum of 30 hours required. Examinations: All GBCB students must pass a preliminary and a final exam. The preliminary exam, oral and written, is conducted by the student's advisory committee. Between the third and fourth years, each student must prepare a dissertation research plan and give an oral defense of that plan and the scientific foundations on which it is based. The dissertation research plan is expected to be a refinement of the initial research plan presented presented by the student to his committee at the end of the second year. The proposal is to be prepared in an NIH-style format and should provide a clearly defined description of the research the student plans to complete.The oral defense of the plan will include questions both directly related to the proposal as well as more general questions that examine the student's knowledge of fundamental principles.The student may be tested on any aspect of his proposal, the philosophy of science, and research methodology. It is recommended that the student meet with his/her advisory committee prior to preparing for the exam to discuss the nature of the exam and evaluation procedures.The final exam, oral and written, is primarily a defense of the dissertation, but other areas of science may be included.

GRADUATE COURSES (GBCB)

GBCB 5004:

Seminar in Genetics, Bioinformatics, and Computational Biology

Review and discussion of current topics and literature in genetics, bioinformatics, and computational biology by students, Virginia Tech faculty, and outside speakers. Students give formal presentations of research results or current literature. May be repeated. Pre: graduate status in the Program in Genetics, Bioinformatics, and Computational Biology or in a department that offers the Bioinformatics Option.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GBCB 5314 (PPWS 5314):

Biological Paradigms for Bioinformatics

This course is an intensive introduction to the central paradigms of molecular cell biology for bioinformatics. Material from cell molecular biology, and genetics will be presented, and placed in a genomics context. The course prepares students in mathematical disciplines to interact in teams in the pursuit of bioinformatics research. Pre: Senior or graduate standing in mathematically-based disciplines such as computer science, statistics, mathematics or engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GBCB 5424 (CS 5424) (BIOL 5424):

Computational Cell Biology

Use of mathematical models (nonlinear ordinary differential equations and stochastics processes) and simulation algorithms to explore complex feedback circuits that control the behavior of living cells. Concepts and techniques from dynamical systems theory, bifurcation analysis, numerical methods, SBML (systems biology makeup language) and Matlab programming. Applications in gene regulatory networks, cell cycle control, circadian rhythms, cell signaling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MATH 5515

Corequisite(s):

GBCB 5515 (MATH 5515):

Mathematical Methods for Modeling and Simulation of Biological Systems

Introduction to mathematical techniques for modeling and simulation, parameter identification and analysis of biological systems. Emphasis on both theoretical and practical issues and methods of computation, with concrete applications. Suitable for students from the mathematical and life sciences who have a basic foundation in multivariate calculus and ordinary differential equations. 5515: Continuous models and methods. 5516: Discrete models and methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GBCB 5874:

Problem Solving in Genetics, Bioinformatics, and Computational Biology

Research practicum in genetics, bioinformatics, and computational biology. Emphasis on the multidisciplinary and collaborative nature of research in genetics, bioinformatics, and computational biology. Exposure to the scientific method, the nature of research tools, strategies for publishing, and opportunities for research careers in genetics, bioinformatics, and computational biology. Permission required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GBCB 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

GBCB 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 9

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GBCB 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GEOGRAPHY

Thomas Crawford, Chair

Professors: James Campbell; Laurence Carstensen; Thomas Crawford; Andrew Ellis; Korine Kolivras; Lynn Resler;

Associate Professors: Timothy Baird; Luke Juran; Lisa Kennedy; Robert Oliver; Thomas Pingel; Yang Shao;

Assistant Professors: Anamaria Bukvic; Craig Ramseyer; Stephanie Zick;

General Contact: geog@vt.edu

Graduate Site: http://geography.vt.edu/PROGRAMS/graduate.htm

The graduate program in geography consists of an MS degree in Geography and a PhD. degree in Geospatial and Environmental Analysis. The MS degree develops specialists for academic, agency and industry positions though emphasis on: Making appropriate use of methods for geographic inquiry to determine, to analyze, and to interpret spatial and temporal patterns and processes Identifying debates and gaps in the current literature to define an original research question Conducting research, collecting primary or secondary data, defending, and presenting their findings in publishable form At the doctoral level, the emphasis is on preparation for research careers with agencies or in academia as: students will demonstrate advanced proficiency in geospatial analysis in an interdisciplinary environment students will conduct and defend independent research that contributes to the literature students will identify and apply appropriate statistical methods for specific research questions

SPECIAL FACILITIES

The department is housed in Major Williams Hall on the upper quad of the campus. The department occupies the entire first floor of the building with faculty offices and laboratory space.

Biogeography Laboratory

Two Biogeography Laboratories offer advanced facilities for the study of recent and long-term environmental history and vegetation change through analysis of lake sediment and/or tree rings. Equipment resources include refrigerated storage, computers, several Leica compound microscopes with digital imaging capability used in paleoecological research, a Colinvaux-Vohnout Sediment Coring system, Fume Hood, isotemp Furnace, and a Velmex tree-ring measurement system used in dendrochronological analysis.

Geospatial Laboratory

The Department's GIS Laboratory offers 18 Windows 7 workstations for classes and for research, including specialized systems for GIS, cartography, and remote sensing. Software packages include the complete suite of ArcGIS, ArcEngine, Surfer, Python, Visual Studio, Trimble GPS Pathfinder, ERDAS IMAGINE, ENVI/IDL, and eCognition.

Physical Geography Laboratory

The Physical Geography Lab includes equipment for soil sampling, sample desiccation and microscopic viewing.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (154.0), Quantitative (156.0)

The MS program in geography emphasizes developing professional competence in the tools, substance, methodology, and theory of the discipline. Thesis and non-thesis options in the 30 semester hour program prepare students for a variety of careers in teaching, research and planning organizations, business and government.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (154.0), Quantitative (156.0)

The Geospatial and Environmental Analysis PhD. degree is housed in the College of Natural Resources and Environment and the Department of Geography is the home to about 60% of its students. The degree requires that students become proficient in the use of Geographic Information Systems and Remote Sensing and that their research make use of those tools in environmentally oriented research.

GRADUATE COURSES (GEOG)

GEOG 5004:

Current Geographic Research

Current research in geography and in allied fields. Presentations and workshops conducted by students, faculty, and on-and off-campus visitors. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5014:

Geographic Theory and Research

Study of how physical geography, human ecological concerns, and the spatial perspective have been synthesized into a unified academic discipline. Formulation of geographic research problems, including collection, organization, and analysis of geographic data.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5034:

Analysis of Spatial Data

Methods of describing and analyzing spatial distributions, including spatial autocorrelation, quadrat analysis, trend surface analysis, and methods of map comparison. Applications to student research problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5064:

Elements of GIS

Foundations and applications of Geographic Information Systems (GIS); geographic coordinate systems, Cartesian map projections, spatial data sources, efficient GIS data structures, map representations, and spatial applications of GIS. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5074G:

Advanced Medical Geography of Infectious Diseases

Examination of geographic patterns of infectious diseases and underlying explanatory processes at spatial scales ranging from global to local. Interactions between natural and social environments and their contributions to infectious disease burdens. Human health impacts of climate variability and change. Application of theories such as landscape epidemiology and methods in medical geography and the social sciences to understanding disease emergence events and pandemics. Examination of role of environmental change and human migration on disease diffusion patterns. Analysis of major factors related to HIV/AIDS epidemic that explain the disease's spatial and spatio-temporal pattern in different social and cultural settings. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5084G (GEOS 5084G):

Advanced Modeling with Geographic Information Systems

Use of automated systems for geographic data collection, digitization, storage, display, modeling and analysis. Basic data flow in GIS modeling applications. Development of proficiency in the use of current GIS software. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): GEOG 5064

Corequisite(s):

GEOG 5104 (FREC 5104):

Seminar in Remote Sensing & Geographic Information Systems

Interdisciplinary seminar devoted to current research in the fields of remote sensing, Geographic Information Systems, and related topics. Seminars, workshops, and presentations conducted by students, faculty, and visitors. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5134 (GEOS 5844):

Advanced Interdisciplinary Issues and Ethics in Water Resources

Issues and ethics related to water resources, water as a hazard upon human (infrastructure, economy) and ecological (rivers, groundwater) systems, water- and vector-borne disease, climate change, dams, and eutrophication. Multidimensionality of water resources. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5154 (FREC 5154):

Hyperspectral Remote Sensing

Theory of spectroscopy and spectrometry from portable spectroradiometers to airborne and spaceborne hyperspectral sensors as relevant to natural resource applications, including vegetation species identification and vegetative health, soil and peat properties, mineral and geothermal characteristics, and water applications. Practical investigation of research tools and techniques used to analyze hyperspectral data. Prerequisite: Graduate Standing Required

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5214:

Health and the Global Environment

Examination of human-environment relations in the context of health and disease using a global perspective. Investigation of dynamic interactions between humans and the total environment, including the physical, biological, cultural, political, and economic environments, in relation to disease. Analysis of geographic variations in health, disease, and health care delivery, including differences between developed and developing regions and within a variety of human and physical environments.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5224G:

Advanced Tracking Environmental Change

Multidisciplinary approaches to documenting and understanding past environmental change. Methods used to unravel the physical and human drivers of historical and longer-term changes in climate, vegetation, and fire patterns. Application of environmental change data and insights to improve land and conservation management under changing climates. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5314:

Advanced Spatial Analysis in Geographic Information Systems

Theory and application of geographic information systems. Spatial data handling and analysis to facilitate decision-making through the communication of geographic information. Development of such systems from existing data sources using both packaged and student produced software systems.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): GEOG 4084

Corequisite(s):

GEOG 5334G:

Advanced Geospatial Information Technology for Land Change Modeling

Analysis of the spatio-temporal patters of land use and Land Cover Change (LULCC) as observed in satellite images. Tropical deforestation, urbanization, and agricultural intensification. Rates and patterns of LULCC linked to biophysical and socio-economic drivers. Impacts of land change with respect to local climate, biodiversity, water yield and quality, and ecosystem services.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GEOG 5084G

Corequisite(s):

GEOG 5354G (GEOS 5354G):

Advanced Remote Sensing

Theory and methods of remote sensing. Practical exercises in interpretation of aerial photography, satellite, radar, and thermal infrared imagery. Digital analysis, image classification, and evaluation. Applications in earth sciences, hydrology, plant sciences, and land use studies. Field project and report. Review of current research literature. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5374G:

Adv Remote Sensing & Phenology

This course focuses on the analysis of the spatio-temporal of the vegetated land surface as observed in satellite images. Phenological events, such as the first openings of leaf and flower buds, are good indicators of the impact of local and global climate change. The focus of this course will be on satellite image time series used in the derivation of land surface phenology, the appearance and development of phenology other global regions, and the methods developed for the monitoring of phenology with satellite imagery. A major theme will be causes of spatio-temporal changes of phenological events and the effect of global climate change. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GEOG 5354

Corequisite(s):

GEOG 5384:

Programming for Geographic Information Systems

Computational methods of map analysis with the ArcGIS Geographic Information System. Scripting and Visual Basic.NET programming using Environmental Systems Research Institutes ArcObjects library for customization of GIS software to meet research and analytical needs for both the desktop and the web. Pre: 5084G and computer programing experience.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): GEOG 5064, GEOG 5084G

Corequisite(s):

GEOG 5394G:

Web Mapping

Use of web mapping technologies for geographic data collection, storage, analysis, and display. Web mapping topics include history and context, spatial data infrastructures, hardware and software architectures, Open Geospatial Consortium standards, mapping APIs, virtual globes, user-centric design, web cartography. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5404G:

Advanced Geovisualization

Advanced topics in digital and dynamic map production, emphasizing concepts in advanced cartographic design, information visualization, and human-computer interaction. Topics include cartograms, computer aided design, animation, lidar and photogrammetric point cloud visualization, Web Geographic Information Systems, terrain visualization, and virtual geographic environments. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5414G:

Advanced Climate Change and Societal Impacts

Impacts of climate change on different societies. Concepts of adaptation, vulnerability, and resilience. Notions of complexity, uncertainty, and thresholds related to climate change outcomes. Case study analysis of communities affected by climate change. Understanding future and assessing climate vulnerability across various spatiotemporal scales. Scenario planning, foresight analysis, and interactive digital tools. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5424 (GIA 5404):

Topics in Political Geography

Territorial basis of political systems, political processes, and political behavior from local to global scales; evolution of contemporary political geographic patterns, territorial divisions, and process of partitioning the earth.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5444:

Topics in Physical Geography

Investigation of selected advanced topics in physical geography, such as the history of inquiry in the field of physical geography, systems theory, the scientific method in physical geography, scale, complexity, environmental change, and problems of explanation and extrapolation. Even years, May be repeated for credit for a maximum of 9 credit hours with different content. Graduate standing required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5514G:

Advanced Tropical Meteorology

Tropical weather and climate topics: remote sensing and observations; tropical climatology, including regional and large-scale circulations, monsoons, and the El Niño/Southern Oscillation; tropical convection, including the clouds in the subtropics, deep convection in the equatorial region, and tropical cloud clusters and thunderstorms; and tropical cyclones, including their structure, intensity, lifecycle, and formation. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5544 (AAEC 5544) (FREC 5544):

Remote Sensing in the Social Sciences

Principles on the use of remotely sensed (satellite) data in social science research, with key applications in environment, agriculture, and economic development. Basic scripting techniques to extract, visualize, and analyze satellite remote sensing data across the electromagnetic spectrum with cloud-based computing platforms. Development of social science research proposals using remotely sensed data and based on review of relevant seminal and current research articles. Pre: Graduate standing.

Credit Hour(s): 4
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5654 (SOC 5654):

The Global Division of Labor

Theory and research on the globalization of the division of labor during the recent past as well as over the past several centuries. Examines the development of the capitalist world-system including the role of technological forces; the roles of transnational corporations and states in the global economy; the effects of globalization on work and quality of life in the U.S., other developed countries, and the Third World; analyses of globalization in the manufacturing and service sectors; and possible solutions for problems associated with globalization.

Credit Hour(s): 3
Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5764G:

Advanced International Development Planning and Ploicy

Examination of major development theories and contemporary issues and characteristics of low-income societies (industrialization, urbanization, migration, rural poverty, hunger, foreign trade, and debt) that establish contexts for development planning and policy making. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GEOG 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

GEOG 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GEOG 6214 (FREC 6214):

Forestry Lidar Applications

Theoretical underpinning of established and emerging research using light detection and ranging (lidar) technology for forestry applications including detailed terrain mapping and digital elevation models, canopy height modeling, prediction of forest biophysical parameters, forest physiology and the canopy light regime, watershed mapping and stream modeling, ecological modeling, landscape classifications, and wildlife habitat. Advanced research tools and techniques used to analyze lidar data for different applications. Graduate standing required.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): GEOG 5034, (FOR 5254 OR FREC 5254), (FOR 5264 OR FREC 5264)

Corequisite(s):

GEOG 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOG 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GEOSCIENCES

Steven Holbrook, Head

Emeriti Faculty: Thomas Burbey; Kenneth Eriksson; Gerald Gibbs; Michael Hochella; James Read; Akhaury Sinha; J Snoke;

Professors: Robert Bodnar; Mark Caddick; Patricia Dove; Steven Holbrook; John Hole; Scott King; Richard Law; Brian Romans; Nancy Ross; Madeline Schreiber; James Spotila; Robert Weiss; Shuhai Xiao;

Associate Professors: Benjamin Gill; Frederick Michel; Sterling Nesbitt; Ryan Pollyea; Manoochehr Shirzaei; D Stamps; Michelle Stocker; Michael Willis; Ying Zhou;

Assistant Professors: George Allen; Julia Cisneros; Megan Duncan; Cristina Dura; Susanna Werth;

University Distinguished Professor: Robert Bodnar; Patricia Dove;

Research Professors: Martin Chapman;

Senior Instructors: Neil Johnson;

Adjunct Faculty: Eileen Martin; Mitsuhiro Murayama; Philip Prince; William Schmachtenberg; Sheryl Singerling;

Instructors: Laura Neser;

Research Scientists: Sean Bemis; Lowell Moore; Rachel Reid; Vicki Yarborough;

Collegiate Associate Professors: John Chermak;

Graduate Contact: apriln@vt.edu

Department Site: http://www.geos.vt.edu

Virginia Tech's Department of Geosciences focuses on research, education and outreach dealing with the nature of the earth. We offer the MS and PhD degree programs at the Blacksburg campus. Our students and faculty investigate earth processes at scales that range from atomic to planetary. We encourage interdisciplinary approaches to research in the geosciences, both within the department and through interdepartmental programs. More details about the department, faculty, and research programs can be found at http://www.geos.vt.edu/. We encourage prospective students to fill out a pre-application survey and to contact individual faculty to explore research opportunities.

SPECIAL FACILITIES

The Department of Geosciences is currently housed in Derring Hall. (See https://geos.vt.edu/research/Research_Facilities.html for more details on our Derring laboratory and research space.)

Geosciences Research Facilities

Aqueous Geochemistry Laboratory Biogeochemistry of Earth Processes (BGEP) Laboratory Chemical Hydrogeology Laboratory Bone Histology and Thin Section Laboratory Derring Electron Beam Laboratory (Cameca SX50 Electron Microprobe and Camscan Series II SEM) Exploration Geophysics Field Equipment Laboratory Extant Comparative Laboratory Fluids Research Laboratory Fossil Preparation Laboratory Fossil Visualization Laboratory Geochemical Sample Preparation Clean Laboratory Geophysics Computing Facilities Geothermal Database Hydrothermal Synthesis and Experiment Laboratories Laser-Ablation ICPMS Laboratory Light Stable Isotope Laboratory Micropaleontology Laboratory Lithospheric Dynamics and Tectonophysics Laboratory Nanogeochemistry, Mineral Surface Geochemistry, and Biogeochemistry Laboratory Optical Microscopy and Digital Photomicrography Laboratory Physical Hydrogeology Laboratory Radiogenic Helium Laboratory Sedimentology and Stratigraphy Laboratory Structural Geology Laboratory Vibrational Spectroscopy Laboratory Virginia Tech Seismological ObservatoryX-ray Diffraction Laboratory X-ray Fluorescence Laboratory Cameca IMS-7F-GEO Secondary Ion Mass Spectrometer (SIMS) Laboratory (Geosciences Dept. facility housed in the Nanoscale Characterization and Fabrication Laboratory in the Institute for Critical Technology and Applied Science, Corporate Research Center) Cameca SX50 Electron Microprobe (Geosciences Dept. facility housed in the NCFL Laboratory of the Institute for Critical Technology and Applied Science, CRC) ICTAS/NCFL Facility (use available to Geosciences personnel): Dual-Beam FIB, ESEM, EBSD- and EDS-equipped SEMs and multiple TEMs in the Nanoscale Characterization and Fabrication Laboratory in the Institute for Critical Technology and Applied Science, CRC (https://www.ncfl.ictas.vt.edu/)

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Computer: (250.0)

iBT: (80.0)

Paper: (600.0)

IELTS

General Test: (6.5)

The M.S. student must pass a minimum of 30 credit hours, at least 20 of which must be taken as coursework, and at least 6 must be research credits. The final exam for the M.S. degree is a defense of the thesis. The GRE is no longer required.Virginia Tech will accept IELTS scores of 6.5 or higher in lieu of the TOEFL.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)

IELTS

General Test: (6.5)

Ph.D. students must pass a minimum of 90 credit hours, at least 30 of which must be taken as coursework, and at least 30 must be research credits. The department does not give a standardized qualifying exam, but Ph.D. students must take a preliminary exam. The Ph.D. advisory committee shall have responsibility for the make-up and administration of the exam. The exam shall include both an oral and a written portion. Regulations that apply for the exam are: (1) the examination must be taken at least six months before the thesis/dissertation defense, and (2) at least 24 hours of coursework and/or research must remain to be taken at the time of the examination, including work for which the student is currently enrolled. It is recommended that the student meet with his/her advisory committee prior to preparing the exam to discuss the nature of the exam and the evaluation process. The final exam for the Ph.D. degree is a defense of the dissertation. The GRE is no longer required.Virginia Tech will accept IELTS scores of 6.5 or higher in lieu of the TOEFL.

GRADUATE COURSES (GEOS)

GEOS 5014:

Earth System History

Study of the evolution of the atmosphere, hydrosphere, biosphere, and geosphere. Emphasis will be given to the interactions among these components of the Earth system and how these interactions have shaped the history of the Earth.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5024:

Professional Development and Ethics in Geosciences

Skills for success in Geosciences, approaches to critical thinking, scientific communication, professionalism, ethical reasoning, safety in the lab and field, conflict resolution. Pass/Fail Only. Pre: Graduate Standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5084G (GEOG 5084G):

Intermediate Geographic Information Systems

Use of automated systems for geographic data collection, digitization, storage, display and analysis in graduate research. Basic data flow in GIS applications. Overview of GIS applications. Developing research methodology using GIS. Group projects to develop proficiency in the use of current GIS software. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5124:

Geodynamics

Observations leading to the development of plate tectonics. Kinematics of plates on a sphere. Heat flow, mantle convection and viscous flow applied to solid planetary bodies. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5134:

Dynamics of Planetary Surface and Interiors

Structure and composition of the solar system as a constraint on planetary composition. Processes that shape and alter the surfaces and interiors of planets, moons, and asteroids including tectonics, volcanism, impact cratering, regolith formation, mass movement, and weathering. Effect of gravity, heat, pressure, and internal deformation on planets, moons, and asteroids. Derivation of mathematical models to represent surficial and internal deformation processes. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5144 (MATH 5144):

Inverse Theory and Geoscience Applications

Overview of inverse theory, utilizing geophysical examples to illustrate the concepts of model construction, parameter estimation, resolution, and non-uniqueness. Emphasis is on the linear problem, concluding with an overview of nonlinear inversion.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5154:

Strong-Motion Seismology and Seismic Hazard Analysis

Introduction to the generation, propagation, measurement and prediction of strong ground motion from earthquakes, focusing on topics of importance to modern earthquake engineering. Effects of finite fault rupture, source directivity and Earth structure on the propagation of seismic waves; methods for developing ground motion time series for scenario earthquakes, statistical models of the earthquake recurrence process; probabilistic seismic hazard analysis. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5184:

Advanced Geodesy in the Earth Sciences

Study of measurement of Earth 's geometric shape, orientation in space, the gravity field, and how these properties change over time. Geodetic methods of measurement (i.e., GNSS, InSAR, TLS, gravity). Reference frames, geodetic applications, and geodetic advances. Quantitative analysis of geodetic observations with applications to Earth science. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5204:

Terrigenous Depositional Systems

Bedforms and primary sedimentary structures, secondary sedimentary structures including trace fossils, facies, facies sequences, facies models, analysis of Holocene sedimentary environments, and paleoenvironmental interpretation of ancient sedimentary rocks, sedimentation and tectonics. Alternate years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5214:

Carbonate Depositional Systems and Sequence Stratigraphy

Classroom, laboratory and field examination of the temporal and spatial makeup and controls on mineralogy and constituent composition of sedimentary carbonates, sequence stratigraphy of carbonate platforms, paleoclimatic significance of carbonates succession. Introduction to porosity evolution and cementation of carbonates in marine, meteoric and burial realms.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5234G:

Advanced Vertebrate Evolution

Characterization of the evolution of vertebrates from the fossil record to now. Tracing anatomical features in humans to their origin of different vertebrate groups. Chronicling vertebrate diversification events through extinctions, changes in climate in the last 600 million years, biogeography, and phylogenetic methods. Evidence of evolution through fossils and dissection. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5244:

Advanced Morphology of the Vertebrates

Identification of skeletal osteological elements of major groups of vertebrates, including aspects of skeletal functional morphology and homology, with emphasis on extant taxa. Skeletal systems of model and non-model organisms such as fish, amphibians, reptiles, birds, and mammals; specimen care and data management; modern skeletal collection practices. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5264:

Advanced Sedimentary Basins

Formation, evolution, and characterization of regions of the Earths surface that experience long-lived subsidence and sediment accumulation. Integration of concepts and skills from: stratigraphy, surface processes, tectonics, structural geology, burial/thermal history, geo/thermochronology, and geodynamics; content is relevant to fields such as paleontology, (paleo)climatology, and subsurface resource management. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5314:

Advanced Coastal Hazards

Study of past, current, and future drivers of coastal change and hazards. Integration of concepts and skills from: climatic, isostatic, and tectonic processes that drive sea-level change; geologic (e.g., coastal stratigraphy, microfossils) and instrumental (e.g., tide gauges, satellite altimetry) coastal change reconstructions, models, measurements, and projections. Coastal earthquake, tsunami, hurricane, and storm-surge hazards. Approaches and challenges of communicating coastal hazards to the public. Coastal hazards and public policy. Quantitative analysis of coastal change using observational data. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5354G (GEOG 5354G):

Advanced Remote Sensing

Theory and methods of remote sensing. Practical exercises in interpretation of aerial photography, satellite, radar, and thermal infrared imagery. Digital analysis, image classification, and evaluation. Applications in earth sciences, hydrology, plant sciences, and land use studies. Field project and report. Review of current research literature. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5404G:

Graduate Advanced Structure

Basic principles of rock behavior under applied, non-hydrostatic stress (experimental and tectonic) and analysis of the geometrical patterns produced. Graduate students will undertake a more advanced independent research project. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5424:

Structural Petrology

Examination of the processes by which rocks deform due to tectonic stresses, and recognition and interpretation of the microstructures that record these processes. Consent required. Alternate years. II

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5535 (CHEM 5525):

X-Ray Crystallography

5535: Provides a thorough grounding in the principles of the crystalline state including lattices and symmetry, leading to the formal description of structures and surfaces and the interpretation of published crystallographic data. 5536: Covers methods of single-crystal and powder X-ray diffraction for the determination of the atomic arrangement of atoms within crystalline materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5536:

X-Ray Crystallography

5535: Provides a thorough grounding in the principles of the crystalline state including lattices and symmetry, leading to the formal description of structures and surfaces and interpretation of published crystallographic data. 5536: Covers methods of single-crystal and powder X-ray diffraction for the determination of the atomic arrangement of atoms within crystalline materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GEOS 5535 OR CHEM 5525

Corequisite(s):

GEOS 5614:

Advanced Stable Isotope Biogeochemistry

Introduction to the fundamental processes that drive the sorting of carbon, nitrogen, oxygen, hydrogen, and sulfur stable isotopes in modern and past marine and terrestrial systems. Application of stable isotopes to address research questions in a variety of disciplines, including geology, paleobiology, ecology, and other environmental sciences. Collect, prepare, analyze, interpret, and communicate stable isotope data. Experimental design. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5634G:

Advanced Environmental Geochemistry

Application of quantitative methods of thermodynamic and physicochemical analysis to the study of the distribution and movement of chemical elements in surface and near-surface geological environments. Emphasis on using fundamental principles to understand natural systems and solve practical problems in environmental geochemistry. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5704:

Geochemical Thermodynamics

Fundamentals of chemical thermodynamics as applied to earth materials (solid, fluid and gaseous) over wide ranges of pressure and temperature. Derivation of thermodynamic functions from the three laws of thermodynamics. The phase rule, phase equilibria, and Schreinemakers analysis. Comparison of the behavior of real and ideal systems. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5714G:

Advanced Volcanic Processes

Study of characteristics and mechanisms of volcanic phenomena, including magma dynamics, origin and chemistry of lavas, physics of eruptions, and characteristics of volcanic products, particularly pyroclastic deposits. Includes focus on volcanism as a general planetary process, on terrestrial tectonic settings of volcanism and on volcanic hazards. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5754:

Fluids in the Earths Crust

The physical and chemical properties of various fluids of geologic interest and the interaction of these fluids with minerals, rocks, and melts in the earths crust are considered. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5804:

Quantitative Hydrogeology

Rigorous mathematical and physical concepts of fluid flow in porous geological media. The course will focus on the mechanics of groundwater flow in one, two, and three spatial dimensions. Boundary conditions and analytical solutions to subsurface and vadose-zone flow problems will be explored and solved analytically. The mechanics of horizontal and vertical deformation of aquifers due to applied pumping stress will be taught from first principles. Includes problems dealing with steady and transient groundwater flow, Biots equations and three-dimensional consolidation theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5804G:

Advanced Groundwater Hydrology

Physical principles of groundwater flow, including application of analytical solutions to real-world problems. Well hydraulics. Geologic controls on groundwater flow. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5814:

Numerical Modeling of Groundwater

Theory and practice of numerical techniques are developed and applied to fluid flow and transport in ground-water flow systems. Governing equations are formulated using FD and FE techniques with appropriate BCs and ICs. Additional topics include: model conceptualization and grid design in multidimensional systems; practical applications of numerical models including calibration, validation, and prediction; concepts and techniques of advective transport using particle tracking and dispersive transport. Introduction to MODFLOW, MODPATH, MT3D, and others.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5834:

Chemical Hydrogeology

Study of solute transport in geologic systems. Focus on processes of advection, dispersion, mineral dissolution and precipitation, chemical reactions and microbially-mediated reactions. Includes use of hydrogeochemical models to simulate chemical transport in geologic systems. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5844 (GEOG 5134):

Advanced Interdisciplinary Issues and Ethics in Water Resources

Issues and ethics related to water resources, water as a hazard upon human (infrastructure, economy) and ecological (rivers, groundwater) systems, water- and vector-borne disease, climate change, dams, and eutrophication. Multidimensionality of water resources. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5924G:

Advanced Tectonics

Overview of modern plate tectonic theory and history. Physical processes driving present-day plate tectonic deformation including continental rifts, rifted margins, continental transforms, strike-slip faults, subduction zones and orogenic belts. Plate kinematic concepts and information about the Earth’s structure. Application of scientific method, data analysis, and computational modeling. Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

GEOS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GEOS 6104:

Advanced Topics in Geophysics

Advanced analysis of one or more topics of geophysics using the most recent techniques, interpretations, and data. Can be taken up to three times provided the subject material is different. Consent required. Alternate years.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6204:

Advanced Topics in Sedimentology

Advanced analysis of one or more topics in sedimentology using the most recent techniques, interpretations, and data. Can be taken up to three times provided the subject material is different. Consent required. Alternate years.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6304:

Advanced Topics in Paleontology

Advanced analysis of one or more topics in paleontology using the most recent techniques, interpretations, and data. Can be taken up to three times provided the subject material is different. Consent required. Alternate years.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6404:

Advanced Topics in Structure/Tectonics

Current ideas and research problems in structural geology and tectonics. Can be taken up to three times provided the subject material is different. Consent required. Alternate years.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6504:

Advanced Topics in Mineralogy

Current research in the major mineral groups subdivided by crystallographic, crystal chemical, or petrogenetic affinities. May be repeated up to three times. Alternate years.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6604:

Advanced Topics in Geochemistry

Advanced analysis of one or more topics of geochemistry using the most recent techniques, interpretations, and data. Can be taken up to three times provided the subject material is different. Consent required. Alternate years.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6704:

Advanced Topics in Petrology

Advanced analysis of one or more topics of petrology using the most recent techniques, interpretations, and data. Can be taken up to three times provided the subject material is different. Consent required. Alternate years.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GEOS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GEOSPATIAL AND ENVIRONMENTAL ANALYSIS

Thomas Crawford, Chair

Professors: Thomas Crawford; Andrew Ellis; Korine Kolivras; Lynn Resler; Randolph Wynne;

Associate Professors: Timothy Baird; Zachary Easton; John Galbraith; Luke Juran; Marcella Kelly; Lisa Kennedy; Kevin McGuire; Robert Oliver; Thomas Pingel; Yang Shao; Valerie Thomas;

Assistant Professors: Megan O'Rourke; Meredith Steele; Stephanie Zick;

Research Professors: William Ford; Jeffrey Marion;

General Contact: yshao@vt.edu

Graduate Site: https://geography.vt.edu/Academics/gea.html

Student Handbook:

https://geography.vt.edu/content/dam/geography_vt_edu/New-GEA-Guidelines.pdf

The interdisciplinary doctoral program in Geospatial and Environmental Analysis focuses on the application of geospatial analysis for improving the science, management, and conservation of natural resources and the environment. Based in the College of Natural Resources and Environment, the program draws upon the expertise of faculty from the Departments of Forest Resources and Environmental Conservation, Geography, Fisheries and Wildlife Sciences, and Sustainable Biomaterials, as well as from those in departments in other colleges, including Crop and Soil Environmental Sciences, Civil and Environmental Engineering, and Biological Systems Engineering. Geospatial research involves Geographic Information Systems (GIS), the Global Positioning System (GPS), remote sensing, and imagery analysis. Environmental analysis focuses on the complex interactions among people, nonhuman biota, and environmental conditions. This doctoral program combines cutting-edge training and research in the theory and application of geospatial science with environmental analysis to enhance research on a broad range of contemporary natural resource and environmental issues. Graduates will be prepared for careers in higher education, government, research, and industry.

SPECIAL FACILITIES

The program has a wide range of facilities necessary for advanced training in geospatial and environmental analysis, including state-of-the art labs for GIS and for biogeography (for the study of recent and long-term environmental history and vegetation change). The Center for Environmental Applications of Remote Sensing (CEARS), housed in the College of Natural Resources and Environment, is a world-class geospatial research facility established in 1997 as a NASA center of excellence in applications of remote sensing to regional and global integrated environmental assessments. With core faculty in both the Geography and Forest Resources and Environmental Conservation departments, it is Virginia Tech's focal point for interdisciplinary research, instruction, and outreach focused on remote sensing applications. Doctoral candidates in this program will have the opportunity to interact with CEARS researchers who have extensive expertise with a wide variety of data types (including active and passive microwave, multispectral, hyperspectral, lidar, aerial photographs) and application areas (such as temperate and tropical forestry, limnology, ecological modeling, marine biology, environmental monitoring, urban ecology, carbon sequestration, tropical biodiversity assessment, phenology studies, rangeland management, invasive species, and fire fuel loading).

Facilities, Equipment, and Other Resources

Facilities, Equipment, and Other Resources Principal resources and facilities available to GEA students include those in student departments and within the College's Center for Environmental Applications of Remote Sensing (CEARS). Below are those within the Department of Geography and CEARS. Geography Department Lab: Hardware: 33 Dell Precision 3630 Processor: INTEL 6 Core I7 at 3.2 Ghz Ram: 32 GB per system Internal Storage: 1 Tb solid state GPU: NVIDIA GeForce GTX 1060 with 6 Gb VRAM Periperals: HP Designjet T730 large format printer Relevant Software's: complete suite of image processing (ENVI, ERDAS Imagine) and associated software, including compilers (IDL, Absoft Fortran, Matlab, Visual Studio, Python), statistical packages (R, SAS), and GIS (ESRI products). College of Natural Resources and Environment, Center for Environmental Applications of Remote Sensing (CEARS) Lab: Hardware: 22 networked (1 Gbit) Precision Workstations (15 - Quad core Xeon with 64 Gb ram, 7 - Six core Xeon with 128 Gb ram) Internal Storage: 3 Tb Peripherals: HP Designjet T730 large format printer Relevant Software: complete suite of image processing (ENVI, ERDAS Imagine) and associated software, including compilers (IDL, Absoft Fortran, Matlab, Visual Studio, Python), statistical packages (R, SAS), and GIS (ESRI products). GPS equipment available: 4 Trimble GeoXT 18 Garmin Etrex Meteorological Equipment: 3 ea Campbell Scientific mobile metrological units: RM Young wind monitor, CSL Temperature/RH probe, Sentra 278 Barometer, Garmin GPS receiver, CR800-ST-SWNC Measurement & Control Datalogger Handheld Field Spectrometer: ASD PANalytical FieldSpec Handheld 2 Field Spectrometer, 325-1075nm. w/wforeoptics and Rad.Cal.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (153.0), Quantitative (156.0), Analytical Writing (4.0)

Students must complete 90 credit hours and a dissertation that involves original research. The program has three areas of required coursework totaling 31 credits. The first is composed of required Core Courses consisting of: 14 hours of classes that provide training in advanced research techniques, statistical and spatial analysis, ethics, diversity and inclusion training, and discussion of contemporary issues in GIS and remote sensing. 12 hours of electives in geospatial classes involving both GIS and remote sensing. 6 hours of classes from electives in environmental analysis. Students must also complete a minimum of 30 hours of Research and Dissertation and 29 hours of other coursework and/or additional hours of Research and Dissertation. Students can transfer all approved graduate coursework taken at Virginia Tech prior to enrolling in this program and up to 15 hours of coursework from another university.

GOVERNMENT AND INTERNATIONAL AFFAIRS

Ariel Ahram, Chair

Professors: Ilja Luciak; Timothy Luke; Joel Peters; Ioannis Stivachtis; Gerard Toal; Edward Weisband; Kris Wernstedt;

Associate Professors: Ariel Ahram; Giselle Datz; Matthew Dull;

Assistant Professors: Chad Levinson;

Adjunct Faculty: Georgeta Pourchot;

Professor of Practice: Joyce Barr;

General Contact: elia@vt.edu

Graduate Contact: ahram@vt.edu

Graduate Site: https://spia.vt.edu/programs/gia.html

Student Handbook: https://www.gia.vt.edu/degrees-certificates/masters/

The analysis of government and international affairs during the 21st century clearly constitutes a complex and interdisciplinary set of challenges. To be effective, such study requires knowledge from all of the social sciences and humanities. This program in the School of Public and International Affairs (SPIA) draws insights from these areas of learning into the multidimensional study of governance processes in all levels of society and international affairs. The faculty and students in the Government and International Affairs (GIA) program work jointly to cultivate their experience, knowledge, and skill with regard to the governance practices, political institutions, social dynamics, cultural values, workplace conditions, spatial formations, historical trends, and ethical conflicts that intersect in the workings of government, business, and not-for-profit organizations. Therefore, methodological pluralism is the foundation of GIA's scholarly pursuits. This program approaches the challenges of governance and international affairs comparatively, empirically, and historically at each level of activity and analysis to see how the processes of globalization are being shaped and what their implications may be. We also consider carefully the requirements for more democratic governance of the economy and society. The faculty's key educational objectives are to conduct research, perform service, and train graduate students at both the master and doctoral levels of study in a manner that can engage the GIA program as well as the larger School of Public and International Affairs at Virginia Tech in the public life of our nation and the world. Through this work, the GIA program contributes to the development of new knowledge, enhances global well-being, and prepares all its graduates with the latest skills for conducting their research, service, and teaching. The Government and International Affairs Program offers two graduate degrees: a Master's in Public and International Affairs (MPIA), and a Ph.D. in the Governance & Globalization (G&G) Stream of the Planning, Governance & Globalization Ph.D. program (PG&G), which is a wide program in which most of the departments, programs, and schools in the College of Architecture and Urban Studies now participate. The goal of these two GIA graduate programs is to prepare SPIA graduates for a life-long, rich, and full engagement in public activity, continuing professional development, and effective service as academics, government officials, journalists or technical experts in the vitally important fields of government and international affairs. The overall unifying focus of the School of Public and International Affairs is directed at issues in politics, policy, planning, and practice. GIA students will work closely with faculty and students in the school's two sister programs Public Administration and Public Policy as well as Urban Affairs and Planning and those departments in the other collegiate units at Virginia Tech that can assist them with their education.

SPECIAL FACILITIES

MPIA is offered at Virginia Tech Research Center-Arlington, 900 N. Glebe Rd, Arlington Va. 22203 Contact Elia Amegashie, elia@vt.edu

Architecture Annex

Architecture Annex, 140 Otey St. NW

Facilities

Virginia Tech Research Center-Arlington, 900 N. Glebe Rd., Arlington Va. 22203

DEGREES OFFERED

MPIA Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (620.0), Essay Writing Score (4.5)

Computer: (260.0), Essay Writing (4.5)

iBT: (105.0), Essay Writing (26.0)

GRE [Optional]

General: Verbal, Quantitative, Analytical

MAXIMUM AND MINIMUM REQUIREMENTS FOR MASTERS DEGREE Project and Report (Choice of Major Paper or Practicum)* Option5000-6000 level courses 33 credit hours5904 Project & Report 3 credit hours or5964 Field Work/Practicum 3 credit hoursThesis Option5000-6000 level courses 30 credit hours5994 Research & Thesis 6 credit hoursTotal Hours for all Capstone Options: 36 credit hours[Further information found in Student Handbook] All MPIA students have Major Paper or Practicum as options. Full-time students have Thesis option.

GRADUATE COURSES (GIA)

GIA 5004 (UAP 5004):

Power and Policy in the U.S.

Social science theory and research on the distribution of power in the US, especially as it shapes important national policy outcomes. Institutional and class bases of power will be examined, including membership on corporate boards and in policy-shaping think tanks. Implications for democracy in society will be drawn. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5034 (PAPA 5034) (UAP 5034):

Democratic Governance in the Economy

Interplay between democratic politics upon economic relations, with special focus on the intellectual foundations of capitalist development and consequences of financial disruption to economic policy making. Evolution of state-market interactions and of global governance institutions. Case studies of financial crises and their political implications. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5115 (PSCI 5115):

Research Methods I

The purposes, problems, and strategies of political science research, emphasizing concept and hypothesis formulation, operationalization, research design, data collection techniques, data processing, and multivariate data analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5116 (PSCI 5116):

Research Methods I

The purposes, problems, and strategies of political science research, emphasizing concept and hypothesis formulation, operationalization, research design, data collection techniques, data processing, and multivariate data analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5214 (PSCI 5214):

Contemporary Political Theory

Selected topics in contemporary political theory, including different models of social science inquiry and the use of basic concepts like power, ideology, rationality, and the state in the study of politics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5224 (PSCI 5224):

Perspectives Pol Theo

Analysis of selected perspectives on politics including rational choice theory, critical theory, neo-marxism, neo-conservatism, post-industrialism, and post-structuralism.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5254 (PSCI 5254):

Global Conflicts

Examines theoretical issues in the study of global conflicts. Reviews theories of nationalism, states and territory as factors. Examines dynamics of contemporary conflicts from different regions of globe as case studies illustrating theoretical issues. Reviews role of leaders in conflict processes. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5274:

Comparative Social Movements

This course will investigate the forms of public protest that occur all over the world, with special attention to activism in poor nations and to the recent emergence of transnational movements. Also examines why and when governments repress social movements. Explores movements that are grounded in collective identities based in class, race/ethnicity, gender, religion, and culture. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5284 (PSCI 5284):

Transnational Migration

Overview of the dynamics, policies, governance, and citizenship regimes associated with the phenomenon of transnational migration. The course will emphasize local, national, and supranational examples and comparisons to explore these themes. Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5314:

Middle East Geopolitics

Key issues in international relations in the Middle East, including impact of political geography, emergence of regional systems, relationship between identity and citizenship, domestic and transnational political contestation, and U.S. regional policy. Application of theories of social change to examine linkage between citizenship, religion, and political authority. Focus on Iraq, Iran, Syria, Lebanon, and Persian Gulf region.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5354:

Public Policy Analysis

Approaches to policy analysis and program evaluation including the techniques appropriate to various stages of the policy process.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5364 (PSCI 5364) (STS 5364):

Public Ecology

Examines policy developments and practices that move beyond the conceptual divisions and policy operations begun during the 1970s, which largely divided the more natural science- based environmental sciences from social science-based environmental based studies. Mixes the insights of life science, physical science, social science, applied humanities, and public policy into a cohesive conceptual and operational approach to environmental protection in the 21st century. Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5374 (PSCI 5374):
Electronic Governance
Examines applications of information technology in government from the point of view of governments and citizens. Survey of the relationship between e-government and e-democracy and of government management techniques. Explores problematic issues related to e-government, such as privacy, the digital divide, and information security.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5214, PSCI 5554 OR UAP 5564
Corequisite(s):

GIA 5404 (GEOG 5424):
Topics in Political Geography
Territorial basis of political systems, political processes, and political behavior from local to global scales; evolution of contemporary political geographic patterns, territorial divisions, and process of partitioning the earth.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5414 (PSCI 5414):
Industrial Democracies
Political pattern and processes of development in selected democracies in Europe, North America, and Asia emphasizing the political problems of contemporary industrial societies and their likely evolution in a post-industrial era.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5424:
Comm & Post-Comm Sys
Political processes and developmental trends in communist and post-communist systems in Russia and other CIS states, Eastern Europe, the Peoples Republic of China, and the Third World. Current economic, political, and social issues and their likely development.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5434 (PSCI 5434):
Politics of Developing Areas
Political structures, economic growth, and cultural frameworks of developing nations in Asia, Africa, and Latin America emphasizing the political and economic challenges of industrial development in a global economy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5444 (PSCI 5444):
International Politics
Theories of international organizations and relations among nations focusing on research in foreign policy formulation and implementation, international integration, conflict resolution, and global political economy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5454:

Adv Info Tech Policy

In-depth study and critical evaluation of selected complex issues related to information technology, society, governance, and public policy. Focused attention is given to theoretical and methodological foundations of the area of inquiry and to specific domains of policymaking and implementation. Topics will be selected from IT-related issues in such areas of concern as: cities, local communities, nonprofit organizations, governments, and global networks. May be repeated on a different topic. Must meet prerequisite or have permission of instructor.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5464 (UAP 5464):

Qualitative Research Methods in Global Studies

Examines the philosophies and procedures guiding various qualitative methods used in the social science fields, such as global studies, planning and policy. Exploration of alternative understandings of normal science and consideration of the merits of adopting qualitative research approaches to disciplined analysis, including ethical issues in research. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5474 (PSCI 5474):

Global Governance

Examination of the norms, institutions and practices developed by the international community to address systemic global governance problems: genocide, failed states, transnational corruption, displaced persons, AIDS, poverty. Role of United States in world community examined. Power of international organizations versus states. Capacity problems of both. Future of United Nations and global governance considered. Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5484 (PSCI 5484) (HIST 5484):

Contemporary American Foreign Policy

Covers U.S. foreign policy during the Cold War, the stalemate with the Soviet Union, armament and arms control, containment and deterrence, detente and Reaganism, and the end of the Cold War. Briefly covers events from 1989 to the present. Designed for students with an interest in foreign policy and global affairs. Prereqs or instructors permission.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5214, PSCI 5444

Corequisite(s):

GIA 5504 (UAP 5504) (PSCI 5504):

Discourse Analysis

Examines the key theoretical sources and major practical applications of discourse analysis as a contemporary social science methodology. Origins, major variants, and critical uses of discourse analysis in cultural studies, semiotic methods, policy analysis, and organizational communication techniques also are considered. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5514 (PSCI 5514):

Global Security

Security examined as an essentially contested concept. Traditional national security and emergent global security discourses and agendas explained. Security institutions and organizations analyzed. Questions of power, identity and representation examined as factors delimiting security conceptions, practices and agendas. Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5524 (UAP 5524):

Internat Development

Social and cultural factors in the development of societies, including the role of women in development. Contemporary developing countries, and historical material from developed countries; policy issues facing

governments of developing countries and those interested in assisting their development.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5554 (PSCI 5554):
Cult Pol Soc Network
Historical origins, institutional foundations, and theoretical interpretations of cultural, political, and social interaction through computer mediated communication are examined. Particular attention is given to new types of discourse, sources of power, and structures of society at all geographical levels in global computer and communications networks.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5564:
Women and Globalization
Feminist theoretical paradigms that analyze impacts of globalization on women and girls. Impacts of globalization on households and families. Relationship between globalizing processes and gender inequalities. Addresses feminist controversies and womens transnational resistance.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5584 (PSCI 5584) (UAP 5584):
Environmental Politics and Policy
Course provides a broad introduction to the key ideas, actors and institutions related to environmental politics and policy in the United States, with some coverage of global issues. It is intended to provide students with basic interdisciplinary knowledge and an intellectual framework for understanding and thinking critically about environmental politics and policy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5614 (PSCI 5614) (HIST 5544):
Understanding The Israeli Palestinian Conflict
Dynamics of the Israeli-Palestinian conflict. Critical issues that underlie the conflict and divide Israel and the Palestinians. Diplomatic efforts aimed at resolving the conflict. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5624 (PSCI 5624):
Conflict Resolution and Peace Building
Comprehensive guide to contemporary conflict resolution. Strategies and approaches for mitigating and resolving conflict. Process of conflict transformation and reconciliation. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5634:
Global Social Policy
History of national and global welfare regimes since WWII. Theories of comparative welfare regimes and the emergence of global welfare regimes. Application of theories of social rights and human rights to contemporary issues in social policy at a global level and intersections with international development policy. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 5664:
Energy and Environmental Security
Effect of energy and natural resources on conflict, security, and risk. Theories of scarcity and human ecology pertaining to causes of wars and insecurity. Identification drivers of risk, resilience, and sustainability

through case studies and statistical data related to different natural resources. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5704:

Transatlantic Relations

Development and institutionalization of transatlantic political, economic, and security relations. Bilateral and multilateral cooperation frameworks. Theoretical, historical, civilizational, and cultural approaches to the study of transatlantic relations. Impact of the changing security context, domestic politics, and national interests on the evolution of transatlantic relations and common identity. Political and economic causes of tensions and discord between the United States and its European allies and their impact on European security and world order. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5714:

European Union

Theories of European integration. History, organizational structure, political dynamics, decision-making mechanisms, and policy-making processes of the European Union (EU). EU's political system and international actorness. Survey of EU's major internal and external policies and their impact on transatlantic political, economic, and security relations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5724:

European Political Economy

The politics of European economic integration. Organizational structure, decision-making mechanisms, policy-making processes, and policies of major European and transatlantic economic institutions, such as the European Union (EU), the European Free Trade Association (EFTA), the European Economic Area (EEA), the Eurasian Economic Union (EEU), and the Organization for Economic Cooperation and Development (OECD). Domestic politics and their impact on European and transatlantic economic organizations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5734:

European Politics & Society

Examination of the political and economic development in Europe. Identification and analysis of the factors leading to the transformation of European politics and markets. Exploration of government, parliamentary, electoral, judicial and party systems in Europe. Investigation of the relationship between state and society in Europe. Examination of the impact of political culture and ideologies on political participation and organized political movements. Investigation of the role of the media and public opinion in European politics. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5744 (PSCI 5744):

European Security

Exploration of European security governance. Scope, evolution, structure, decision-making mechanisms, policy-making processes, policies and operations of major security organizations in Europe, such as the North Atlantic Treaty Organization (NATO), the Collective Security Treaty Organization (CSTO), the European Foreign & Security Policy (CFSP) and Common Security and Defense Policy (CSDP), the Council of Europe (CoE), and the Organization for Security & Cooperation in Europe (OSCE). Identification and analysis of the politics and interests affecting their operation. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5904:

Project and Report

The major paper is one option (together with the Practicum and Thesis) which GIA candidates may elect to complete their degree requirements. It provides the candidate with an opportunity to demonstrate: (1) a required degree of comprehension of the concepts, principles and theories relevant to their fields and (2) the ability to apply this understanding in a professional manner to a specific policy, planning or methodological issue by means of a sustained analytic argument. The exact character of the concerns to be examined in a major paper will be approved by a students committee and may take the form of case studies, literature reviews, or sustained examination of policy or planning processes or outcomes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

GIA 5914:

Peace Corps Service Credits

Critical evaluation and field-based study of selected complex issues related to society in international context; study of cultural and language diversity; approaches to ethnoinclusiveness in urban and rural environments; focus on practical local and regional planning for the benefit of local communities in consort with nonprofit organizations, governments and global networks. Prerequisite: Graduate Standing and enrollment in Masters International Program and Peace Corps.

Credit Hour(s): 6

Lecture Hour(s): 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5964:

Field Work/Practicum

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

GIA 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

GIA 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GIA 6114 (PSCI 6114):

Critical Geopolitics

Critical analysis of geopolitics as spatial discourse about world politics. Examines major concepts in critical geopolitics. Critically reads colonial, fascist, Cold War and post-Cold War geopolitical discourses. Discusses geopolitical knowledge in popular culture. Reviews latest research in the field of critical geopolitics. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5444

Corequisite(s):

GIA 6124:

Topics in Security Studies

Surveys the interface of globalization and security and the changing paradigm of security within global society. Reviews the impact of globalization on traditional understandings of state security, and provides an advanced understanding of the emerging challenges and threats to human and state security. May be repeated with a different topic content

for a maximum of 12 credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): GIA 5444 OR PSCI 5444 OR GIA 5514 OR PSCI 5514
Corequisite(s):

GIA 6134:

Topics in Conflict Analysis

Provides a comprehensive guide to the understanding of contemporary global conflicts and conflict resolution. Reviews the field of conflict analysis, demonstrates the various approaches to conflict resolution and explores the dynamics of conflict settlement. May be repeated with a different topic content for a maximum of 12 credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): GIA 5254 OR UAP 5254 OR PSCI 5254
Corequisite(s):

GIA 6144:

Topics in Global Governance

Provides a comprehensive guide to understanding of contemporary power pressures and responses to global economic and financial change along with its political and social repercussions. Reviews the fields of international political economy, demonstrates the various approaches to adherence and resistance to globalization, and explores the dynamics of the relationship between states and markets. May be repeated with a different topic content for a maximum of 12 credits. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): GIA 5034 OR UAP 5034 OR PSCI 5034
Corequisite(s):

GIA 6154:

Topics in European Politics

Analysis of selected European political issues. Democracy and populism. Nationalism, fascism and racism. Religion and religious radicalism. Culture and society in European urban and rural areas and its impact on contemporary European politics. Gender politics and attitudes towards women and LGBTQ in Europe. Social foundations and cultural determinants of marginalization of social groups, migrants and refugees. May be repeated three times with different content for a maximum of twelve (12) credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5734 OR GIA 5734
Corequisite(s):

GIA 6164:

Topics in Transatlantic Relations

Selected political, cultural, religious, economic, diplomatic and security issues pertaining to transatlantic relations. Topics under examination include: impact of religion and culture on transatlantic relations; US-EU relations and European security; the transatlantic partnership and world order. May be repeated three times with different content for a maximum of twelve (12) credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5704 OR GIA 5704
Corequisite(s):

GIA 6174:

Topics in EU Policies

In-depth analysis of selected European Union (EU) policies. Topics under examination include the EU's Common Foreign & Security Policy (CFSP), Common Security & Defense Policy (CSDP), environmental policy, energy policy, and climate policy. Organizational structures, decision-making mechanisms, and policy-making processes. Governmental and non-governmental actors and policy-making. Analysis of policy results and effectiveness. May be repeated three times with different content for a maximum of twelve (12) credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5714 OR GIA 5714
Corequisite(s):

GIA 6184:

Topics in European Security

In-depth analysis of major issues in European security. Topics under examination include the relations between the North Atlantic Treaty Organization (NATO) and the European Union (EU) and their impact on European security; Russia and European security; British foreign and

security policy and its impact on European security and transatlantic relations; contemporary threats to European security; and European conflicts and conflict management. May be repeated three times with different content for a maximum of twelve (12) credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5744 OR GIA 5744
Corequisite(s):

GIA 6204 (UAP 5524):
Theories in Globalization
Examination of past and present eras of globalization through various theoretical perspectives. Addresses colonialism and emergence of western models for development of poor countries. Controversies about impacts of current globalization on the nation-state, cultures, ecosystems, and racial/ethnic/gender inequalities. Explores present trends, such as globalization of agriculture and food systems, industrial production, migration, human rights, and anti-globalization resistance. Prerequisite may be substituted for any equivalent 5000 level international course.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): UAP 5264 OR GIA 5264
Corequisite(s):

GIA 6214 (PSCI 6214):
Democracy Beyond the Ballot
Forms of ultra or enhanced democracy outside of state institutions, particularly those developing in third sector organizations, theories of democracy and research on functioning deliberative democracies at the grassroots level, in societal or international institutions. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): GIA 5034 OR UAP 5034 OR PAPA 5034 OR GIA 5164 OR UAP 5164
Corequisite(s):

GIA 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

GIA 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

HIGHER EDUCATION

Sharrika Adams, Program Director
D Chase Catalano, Program Director

Emeriti Faculty: Joan Hirt; Steven Janosik;
Professors: Menah Pratt;
Associate Professors: Claire Robbins;
Assistant Professors: D Chase Catalano; Tonisha Lane;
Assistant Professor of Practice: Sharrika Adams;

General Contact: nbradley@vt.edu
Higher Education: https://liberalarts.vt.edu/departments-and-schools/school-of-education/academic-programs/higher-education-program.html

The Higher Education program at Virginia Tech is built upon collegial relationships between faculty and students throughout the period of graduate study. Faculty serve as teachers, advisors, colleagues, and mentors to students in our Ph.D., M.A.Ed., and Certificate programs. Program Highlights Focus on preparing leaders for postsecondary education who use and produce high-impact research as part of their practice and who are committed to service in both professional and personal contexts Small cohorts and high student/professor interaction Opportunities for student scholarship and research Capstone ePortfolio experience for students in the master's program Graduate assistantships and tuition waivers available for full-time master's and doctoral students A commitment to diversity Part-time and certificate enrollment for working professionals Program Director, M.A.Ed. Program: Sharrika D. Adams, Ph.D., Assistant Professor of Practice 1750 Kraft Drive Blacksburg, VA 24060 540-231-5872 davissd@vt.edu Program Director, Ph.D. and Certificate Programs: Claire K. Robbins, Ph.D., Associate Professor 1750 Kraft Drive Blacksburg, VA 24060 540-231-2004 robbinsc@vt.edu Graduate Program Director: Dr. Nancy Bradley, Associate Director, Office of Academic Programs, School of Education 540-231-5220 nbradley@vt.edu Please access our website for more information about our Ph.D., M.A.Ed., and Certificate programs.

SPECIAL FACILITIES

Faculty members in the Higher Education program hold offices in the building located at 1750 Kraft Drive, Blacksburg, Virginia 24060. This building is situated in the Corporate Research Center, opposite the airport and just off Research Center Drive.

DEGREES OFFERED

MAEd Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

The Higher Education Program offers the M.A.Ed degree only on the Blacksburg campus. Please refer to the program website for specific requirements.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

The Higher Education Program offers the Ph.D. degree only on the Blacksburg campus. Please refer to the program website for specific requirements.

GRADUATE COURSES (EDHE)

EDHE 5105:

Assessment in Higher Education Administration

EDHE 5105: Theoretical, practical, and policy issues in the assessment of student learning outcomes. Principles for evaluation of co-curricular or higher education-related programs, services, or facilities. Assessment of student learning outcomes in those programs and activities. Pre: Graduate standing. EDHE 5106: Application of theoretical, practical, and policy issues in professional education settings such as administrative or service delivery department in higher education. Development of assessment plans, collection and analysis of data, evaluation of findings, and preparation of final assessment reports. Pre: 5105.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5106:

Assessment in Higher Education Administration

EDHE 5105: Theoretical, practical, and policy issues in the assessment of student learning outcomes. Principles for evaluation of co-curricular or higher education-related programs, services, or facilities. Assessment of student learning outcomes in those programs and activities. Pre: Graduate standing. EDHE 5106: Application of theoretical, practical, and policy issues in professional education settings such as administrative or service delivery department in higher education. Development of assessment plans, collection and analysis of data, evaluation of findings, and preparation of final assessment reports. Pre: 5105.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDHE 5105

Corequisite(s):

EDHE 5284:

Practicum in Higher Education

Supervised work experience within a higher education setting. Application of classroom knowledge to the workplace setting in higher education including assessment and evaluation, program development and execution, research, personal development and career planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5304:

Introduction to the Student Affairs Profession

History, philosophy, and goals of the student affairs profession in American higher education. Standards and contexts for student affairs, including scholarly literature related to students and student organizational culture, ethical principles, and professional and quality standards. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5314:

Theories of College Student Development

Theories of college student development. Foundational, integrative, and social identity theories, fundamental criticisms of well-known student development theories, identification of current student populations affected, and applying theories to student affairs practice and personal development. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5334:

The American College Student and the College Environment

Study of the characteristics and attitudes of traditional and nontraditional college students; effect of the college environment on students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5604:

Graduate Seminar in Education

Selected topics in administration, counseling, adult and continuing education, research and evaluation, and community college and other domains of higher education. Emphasis is on interactive discourse on topics not typically included in regularly scheduled courses. (Maximum 3C per course).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

EDHE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDHE 6044:

Governance and Policy in Education

Antecedents of public policy affecting education in the United States, and the relationships between policy making and implementation and educational administration.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 6054:

College and University Administration

Advanced graduate study of the governance and administration of the modern, contemporary university in the United States with a focus on the research literature in the field.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 6064:

Higher Education in the United States

Diversity of institutions of higher learning is examined through variations

in the respective goals and purposes of distinct types of institutions and examined through variations in the constituencies served by different types of institutions and their differential impact on students and faculty.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDHE 6084:

Financial Administration in Higher Education

Financing higher education. Emphasis on examination of the revenue source and patterns of funding and the roles of federal, state, and local governments in the fiscal support of higher education. Methods for the determination of institutional resource allocation, program and financial planning, and the internal allocation and effective use of resources.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDHE 6094:

Educational Administration Processes and Skills

College and university leadership and administration. Focus on executive leadership, governance, development, research, outreach and engagement. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDHE 6114:

Staffing Practices in Education

A study of human resource management in education. Emphasis will be given to recruitment and selection, induction and orientation, supervision, staff development, and performance appraisal practices at all levels of education. Doctoral standing or instructor permission is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDHE 6304:

Theories of Educational Organizations

Study of educational organization theory and behavior. Emphasis will be given to understanding institutional structures and cultures in their educational, social, economic, and political contexts with a view toward organization improvement, development, and reform.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDHE 6404:

Higher Education Research Proposal Design

Conceptualize and write elements of a research proposal suitable for a doctoral dissertation including topic selection, literature reviews, conceptual frameworks, research questions/hypotheses, and select research techniques appropriate for gathering data. Pre: EDRE 6605, EDRE 6606, and EDRE 6524.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): EDRE 6605, EDRE 6606, EDRE 6524
Corequisite(s):

EDHE 6984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDHE 7714:

Internship in Education

Planned program of advanced clinical practice in education through assignment under direct supervision of outstanding practitioner for periods of up to two semesters. (Maximum 24C).
Credit Hour(s): 1 TO 24
Lecture Hour(s): 1 TO 24
Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDHE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HISTORY

Brett Shadle, Chair

Professors: Mark Barrow; Laura Belmonte; Arthur Ekirch; Edward Ewing; Richard Hirsh; Brett Shadle; Peter Wallenstein;

Associate Professors: Danna Agmon; Glenn Bugh; Samuel Cook; Nicholas Copeland; Carmen Gitre; Heather Gumbert; Dennis Halpin; Matthew Heaton; Melanie Kiechle; Marian Mollin; Paul Quigley; Helen Schneider; Robert Stephens; Daniel Thorp; LaDale Winling; Anna Zeide;

Assistant Professors: Amanda Demmer; Edward Gitre; Rachel Midura; Edward Polanco; Jessica Taylor;

Robertson Professor of Civil War Studies: Paul Quigley;

Professor of Practice: Christina Hey;

Graduate Contact: mheaton@vt.edu

Graduate Site: https://liberalarts.vt.edu/departments-and-schools/department-of-history/academic-programs.html#graduate

The Master of Arts program in History provides talented students with advanced training in the professional practice of historical research and pedagogy. The program serves three primary constituencies: students preparing for further graduate work at the doctoral level, those who wish to become secondary school educators, and those planning for careers in a range of public history fields (the program offers a specialized Graduate Certificate in Public History). By preparing broadly-trained practitioners who have research expertise in a chosen field of specialization, the MA in History also offers an excellent foundation for careers in public relations, journalism, law, and public service. Quite apart from its vocational promise, History is a foundational discipline in the humanities, and the serious study of the past is a source of intellectual enrichment and a lifelong endeavor. Applicants requesting a graduate assistantship should apply by February 1. The program also offers scholarships for students interested in Civil War studies through the Virginia Center for Civil War Studies For more information about the graduate program and the application process, please consult our website: https://liberalarts.vt.edu/departments-and-schools/department-of-history/academic-programs/master-of-arts-in-history.html

SPECIAL FACILITIES

The History Department is located on the 4th floor of Major Williams Hall.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal (158.0), Quantitative, Analytical (4.5)

The department offers a Master of Arts in History and a Master of Arts in History and Area Studies (an interdisciplinary program with the Department of Foreign Languages and Literatures). Both degrees require a minimum of 33 credit hours of coursework. Because research and writing are fundamental tenets of the discipline of history, students are expected to complete a major original research project as part of their plan of study. Most students complete this requirement by designing, researching, and writing a thesis. Students who choose the non-thesis option take additional coursework and submit a research paper to complete research requirements. For more information about policies and degree requirements contact mheaton@vt.edu.

GRADUATE COURSES (HIST)

HIST 5104:

Historical Methods

Introduction to the theoretical frameworks and historiographical debates that inform the contemporary research and writing of history. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5114:

U.S. to 1877

American history, from European discovery through Reconstruction. Emphasis on major themes and developments in the emergence of the United States: exploration and settlement; encounters among Europeans, Africans, and Native Americans; achievement of political independence; territorial expansion and political conflict; immigration, industrialization, and urbanization; Civil War, emancipation, and

Reconstruction.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5124:

U.S. Since 1877

Introduction to main themes in U.S. history beginning with post-Civil War industrialization. An intensive readings course emphasizing the social, cultural, political, economic and military changes in the century after Reconstruction.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5134:

Research Methods for Historians

Introduction to skills and methods used in the research, writing and publication of historical scholarship.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): HIST 5104
Corequisite(s):

HIST 5154:

Writing Skills for the Professional Historian I

Writing skills for clear, professional historical writing. Narrative approaches to writing public history, conference presentations, and scholarly publications. Methods of incorporating feedback. Self-editing skills. Pre: Graduate standing.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5194:

Topics in African American History

Variable topics readings course focusing on the particular themes, key scholarly works, and historiographical debates in African American history as well as the multiple theoretical frameworks and historical method used in writing histories of the Black experience. May be repeated once with different content for a maximum of 6 credits. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5205 (STS 5205):

Main Themes in the History of Science and Technology

Methods and concepts in the history of science and technology. 5205: research methods, interpretive approaches, and contemporary issues in the history of science; 5206: research methods, interpretive approaches, and contemporary issues in the history of technology.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5206 (STS 5206):

Main Themes in the History of Science and Technology

Methods and concepts in the history of science and technology. 5205: research methods, interpretive approaches, and contemporary issues in the history of science; 5206: research methods, interpretive approaches, and contemporary issues in the history of technology.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5214 (ASPT 5214):

Topics in Global History

A variable content course exploring historiographical approaches to the study of global history from the classical age to the present. Special emphasis on chronological frameworks, histories and theories of globalization, and implications of new scholarship in global history for research and teaching. May be taken with different content for a total of 6 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5224:

Readings in African History

Variable topics readings course focusing on historiographical trends on particular themes in African history. May be taken with different content for a total of 6 credit hours. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5404:

Science in Modern America

History of science connected to social and policy issues in modern America. Mutual influence between science and cultural factors such as race and gender, military and corporate funding, scientific communities and professionalization, and federal science policy. Diverse theoretical frameworks and research methods for writing about history of science. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5414:

Topics In Cultural History and Theory

A variable content course exploring the intersection of cultural theory and the discipline of history. Introduces important theoretical contributions to the study of culture and examines how historians have used these constructs to interpret the past. May be taken with different content for a total of 6 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5424:

Public History

Introduction to the theoretical, interpretive, controversial, and practical issues facing public historians. Focus on interpretations and specific issues surrounding the presentation of history in museum exhibits, documentary films, photographic collections, community history projects, the Internet, and a variety of other public venues. Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5434:

Oral History Methods

Theory and methodology of oral history methods. Use of oral history interviews in historical research, questions of ethics, interpretation, and the construction of memory. Technical operations and a variety of interview techniques, transcription, and historical use of interviews. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5444:

Digital History Methods

Methods for researching and presenting history in a digital environment, with special emphasis on use of digital media as a tool for public historians. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5454:

Topics in Public History

Current methodological issues facing public history professionals, the intellectual foundations of these issues, and changing standards of practice in the field of public history to engage students in practical,

experiential projects in public history. May be taken for a maximum of 6 credit hours. Pre: Graduate standing.
Credit Hour(s): 3 TO 6
Lecture Hour(s): 3 TO 6
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5484 (GIA 5484) (PSCI 5484):
Contemporary American Foreign Policy
Covers U.S. foreign policy during the Cold War, the stalemate with the Soviet Union, armament and arms control, containment and deterrence, detente and Reaganism, and the end of the Cold War. Briefly covers events from 1989 to the present. Designed for students with an interest in foreign policy and the global affairs. Prereqs or instructors permission.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5214, PSCI 5444
Corequisite(s):

HIST 5534:
Imperialism, Nationalism, and Decolonization
Imperialism, nationalism and their legacies in the twentieth century. Concentration on imperialism and nationalism as categories of historical analysis. Critical examination of the imperial and colonial experiences and of the expansion and transformation of the nation-state system as a consequence of decolonization and global restructuring.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5544 (GIA 5614) (PSCI 5614):
Understanding The Israeli Palestinian Conflict
Dynamics of the Israeli-Palestinian conflict. Critical issues that underlie the conflict and divide Israel and the Palestinians. Diplomatic efforts aimed at resolving the conflict. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5694:
Amer Environ Hist
Examination of the important ways Americans have shaped and been shaped by the natural environment from the time of European contact with the New World to the present. Emphasis on the evolution of environmental concern in the nineteenth and twentieth centuries.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HIST 5904:
Project and Report
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

HIST 5934:
Gender in U.S. History
Theoretical approaches to understanding the role of gender in political, economic and social life and in popular culture. Survey of major themes and developments since the seventeenth century. Concentration on the development of biological and sociological explanations of gender differences and similarities, and on the evolution of gendered politics and work and family relationships. Emphasis given to class, race, ethnic differences and differences in sexual orientation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

HIST 5964:

Field Work/Practicum

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

HIST 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HIST 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HORTICULTURE

Michael Evans, Head

Emeriti Faculty: Susan Clark; Joyce Latimer; Richard Veilleux;

Professors: Eric Beers; Alexander Niemiera; Gregory Welbaum; Mark Williams; Bingyu Zhao;

Assistant Professors: Bastiaan Bargmann; Jayesh Samtani; Sherif Sherif;

Adjunct Faculty: James Altland; Zongrang Liu; James Lowman;

Graduate Contact: spesgradinfo@vt.edu

Graduate Site: https://spes.vt.edu/

The Horticulture graduate program in the School of Plant and Environmental Sciences offers programs leading to the Master's and Doctoral degrees. Areas of specialization include: plant breeding and genetics growth and development physiology molecular biology intensification of production through modern cultural practices and innovative approaches urban horticulture rhizosphere biology agricultural ecology The faculty are stationed both on campus in Blacksburg and at several experiment stations throughout the state. Although not all faculty serve directly as advisors to graduate students, all are available as resources to graduate programs. Note: The MS in Horticulture is available through Agriculture and Life Sciences. Students apply to the MSLFS degree type and select Horticulture as the program.

SPECIAL FACILITIES

On Campus Modern research facilities and several offices are housed in Latham Hall. Offices, a 25-station computer lab, and several classrooms are housed in Saunders Hall. Greenhouse space assigned to the department in the campus greenhouse complex exceeds 20,000 sq. ft. Field research may be conducted at the 10-acre Urban Horticulture Center near campus, at the nearby 1,700 acre Kentland Farm with orchards, vegetable and small fruit plots or at the agricultural experiment stations. The Hahn Horticulture Gardens and Pavilion is an extensively managed six-acre site on campus that supports some of our teaching and outreach effort. Off CampusFaculty are also located at three agriculture research and extension centers (AREC) across the state. The Alson H. Smith, Jr. AREC is located in Winchester where its programs are focused on tree fruit and grapes. The Hampton Roads AREC in Virginia Beach focuses on green industry (nursery and landscape) and small fruit crops research and outreach. The Eastern Shore AREC where Horticulture faculty are located in Painter, on the Eastern shore of Virginia, focuses on vegetable research.

Hahn Horticulture Garden

The Hahn Horticulture Garden encompasses nearly six acres of teaching and display gardens on the campus of Virginia Tech in Blacksburg, Virginia. Established in 1984 by Horticulture faculty, the garden serves undergraduate students and the local community as a learning resource for plant material, landscaping concepts, and environmental awareness.

Kentland Farm

Kentland farm is utilized for research and teaching purposes by faculty members in the College of Agriculture and Life Sciences and by 12 departments in other colleges at Virginia Tech.

Latham Hall

Faculty in the School of Plant and Environmental Sciences are working in Latham Hall to improve human health and nutrition, sustain the environment, and develop resilient and productive cropping systems. Extensive resources for breeding, genetics, physiology, biochemistry, molecular biology, microbiology, plant pathology, microscopy, metabolomics, genomics, tissue culture, plant transgenesis, bioinformatics, and controlled environment experiments are available for graduate research.

Saunders Hall

Five research and teaching laboratories are located in Saunders Hall including agricultural ecology, plant nutrition, and ornamentals research.

Virginia Tech Greenhouses

Virginia Tech's main greenhouse range is located on the corner of Washington Street and Garden Lane, in-between the Hahn Horticulture Garden and McComas Hall. Many departments and programs utilize the greenhouses 51,000 square feet of space for teaching, research and extension activities. Ten wings of glass houses are joined by a central corridor, and eight self-contained fiberglass, polyethylene or polycarbonate houses supplement the main range.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General: Verbal (150.0), Quantitative (150.0), Analytical (4.0)

Minimum Course Requirements for PhD (includes courses accepted by advisory committee from MS); advisory committee may require additional 12 - HORT, CSES, PPWS, BIOL, BCHM, FOR, ENT (5000-6000 level only)6 - Advanced statistics (STAT)1 - Research Ethics in Agriculture and Life Sciences (ALS 5324)2 - Graduate Seminar (SPES 5004)MINIMUM CLASSROOM REQUIREMENT = 22*30-70 Research and Dissertation (HORT 7994)TOTAL CREDIT HOURS REQUIRED = 90*Independent study not applicable; 5000-6000 classes only.Maximum of 11 classroom credit hours can be transferred from a non-VT program.An oral and written preliminary exam and a successful defense of a dissertation are also required.

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal (150.0), Quantitative (150.0), Analytical (4.0)

The MS in Horticulture is available through Agriculture and Life Sciences. Students should apply by selecting Horticulture as the Program and MSLFS as the Degree Type. All MS students, unless enrolled in the On-Line program, are expected to complete a thesis.Course requirements for the MS degree include:ALS 5324: Research Ethics in Agriculture and Life SciencesSPES 5004: Graduate Seminar9 credits in graduate level HORT, CSES, PPWS, BIOL, BCHM, FOR, ENT3 credits in Statistics HORT 5994: Research and dissertation, 6-10 credits30 credits totalStudents interested in the On-Line Masters with emphasis in Horticulture are directed to the OMALS website.

GRADUATE COURSES (HORT)

HORT 5474:

Adv Stud in Urban For Ecosys

The nature and dynamics of urban ecosystems with emphasis on the role of urban forests. Examines the interactions of urban forests with the built environment at multiple scales and from multiple disciplinary perspectives. Management influence on ecosystem processes and approaches to estimating urban forest ecosystem services from urban cores to pre-urban development. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HORT 5514:

Plant Nutrition

Fundamentals of plant nutrient availability, uptake, assimilation, transport, function, and deficiencies. Influence of plant root environment and root physiology on plant nutrient status and subsequent effect on plant growth, crop yield, and relationship to plant diseases and pests. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HORT 5524 (PPWS 5524):

Advanced Plant Physiology and Metabolism I

Plant metabolism and its regulation, cell and organ structure and function. Current understanding of photosynthesis, respiration, nitrogen fixation, mineral nutrition, water and ion transport in plant cells and tissues, ecophysiology and responses of plants to the environment. Pre: undergraduate major in Biology or related discipline.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HORT 5764G:

Advanced Vegetable Crops

Advanced topics in vegetable production, post-harvest handling, economic importance, nutritional value, organic standards, consumption, biotechnology. Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HORT 5784G:

Advanced Vegetable Seeds

Study of vegetable seed production focusing on pollination biology, molecular assessment of seed biology, and current research on seed biology. Seed production, handling, identification, conditioning, enhancement, packaging, storage, testing, federal standards, and biotechnology.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HORT 5764G

Corequisite(s):

HORT 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HORT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

HORT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HORT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HORT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HUMAN CENTERED DESIGN

Ivica Bukvic, Program Director
Donald McCrickard, Program Director

Professors: Ivica Bukvic;

Associate Professors: Donald McCrickard;

General Contact: ico@vt.edu

General Contact: dmccrick@vt.edu

Graduate Site: https://hcd.icat.vt.edu

DESIGN MATTERS The act of creating something new shows up in many human endeavors. It can be a solution to a mundane problem like holding sheets of paper together or something as complex as the formulation of new institutions. Human Centered Design (HCD) is focused on opportunity- and problem-finding, and problem-solving, and is charged with understanding the needs, wants, and limitations of end-users. This is accomplished through methodologies and practices where these considerations are integrated at every stage of the design process.

HCD creates novel learning and discovery opportunities that are needed to train the future professoriate, workforce, professionals and civic leaders. HCD can only be taught in a true interdisciplinary educational environment in which coursework and research embrace diversity, inclusiveness, educational breadth, and interdependence, while promoting a person- and world-oriented, rather than a product-oriented, attitude towards education. INTERDISCIPLINARITY MATTERS Recent trends show that both higher education institutions and government agencies seek employees with interdisciplinary backgrounds, demonstrating strengths in more than one field, and the agility to work with colleagues across fields. To address this, our Interdisciplinary Graduate Education Program (IGEP) provides opportunities for graduate students whose goals cannot be met by a single discipline from a degree granting academic unit at the university. “Real world problems don’t fit nicely into boxes, specific fields, departments or programs,” said Professor of Civil and Environmental Engineering Amy Pruden, who managed the program from 2015-17. “We need to have the opportunity for students so inclined to tackle these problems.” HCD at Virginia Tech provides access to both doctoral degree programs and a graduate certificate program in curricula that combine technical expertise with critical inquiry to develop reflective practitioners equipped to meet vital human needs. The HCD/IGEP program is built around competencies in four core areas: (1) Interdisciplinary Research, (2) Design Studies, (3) Understanding People, and (4) Design Realization. Faculty currently associated with the HCD program come from a diverse disciplinary backgrounds and include faculty from: College of Architecture & Urban Studies Industrial Design School of Visual Art College of Engineering Computer Science Electrical and Computer Engineering Engineering Education Industrial Systems Engineering Mechanical Engineering College of Liberal Arts and Human Sciences English Human Development Learning Sciences and Technology – School of Education Science and Technology in Society Music – School of Performing Arts Theater and Cinema – School of Performing Arts College of Natural Resources and Environment Geography Forest Resources Institute: Institute for Creativity, Art, and Technology (ICAT) HCD is a part of Virginia Tech’s Creativity + Innovation (C+I) transdisciplinary initiative and the Institute for Creativity, Arts, and Technology (ICAT). For additional info visit the HCD website, or contact co-directors Ivica Ico Bukvic (ico@vt.edu) or Scott McCrickard (mccricks@cs.vt.edu).

SPECIAL FACILITIES

Investigations in Human-Centered Design may take the form of creative production, hypothesis-driven research, or phenomenological enquiry. The field’s intrinsic interdisciplinarity draws on facilities from around Virginia Tech, from the studio labs of ICAT to the usability labs of CHCI and beyond.

CHCI

The Center for Human-Computer Interaction The Center for Human-Computer Interaction (CHCI) provides access to a large and diverse set of facilities, software, and equipment. The infrastructure includes a large shared laboratory (the "Black Lab" in VT Knowledgeworks II), a usability lab (in McBryde Hall), Virtual Reality laboratory (the "Sandbox" in the Moss Art Center), secure data transcription and coding labs, several smaller laboratories or project rooms, and meeting rooms. The equipment inventory includes both large fixed assets, such as the Gigapixel Display and the Optitrack motion capture system, and a wide array of portable items such as tablets, cameras, and eye trackers that are available to students and faculty associated with the Center. The Center gratefully acknowledges the support of the National Science Foundation in acquiring this infrastructure. Jointly with ICAT, the Center is currently developing new educational and community studio spaces in the Media Arts Building.

DAAS

Digital Arts and Animation Lab The new Digital Arts and Animation Lab (DAAS) is centrally located in Blacksburg's downtown area. This facility provides students with the high-end tools used throughout industry in the production of digital film, web, and animation content. The lab contains 16 Mac Pro workstations with large 23-inch monitors and loaded with professional industry applications, like Final Cut Pro and Maya. The facility also has an additional small render farm of six 12-core Mac Pros and a state-of-the-art ABS Rapid Prototyper, used for outputting virtual models into Three-Dimensional forms for research and educational purposes.

DISIS

Digital Interactive Sound and Intermedia Studio Digital Interactive Sound and Intermedia Studio (DISIS) complements and recontextualizes the Virginia Tech music technology program by providing the rapidly growing Creative Technologies in Music option. It is equipped by a 24.2 immersive sound system and 20 multi-OS workstations. DISIS is also the home of the World renowned Virginia Tech's Linux Laptop Orchestra (L2Ork). By coupling contemporary technology with traditional performance idioms, DISIS pursues a symbiosis of new forms of artistic expression with special focus on interactive multimedia art and scientific research of new multimedia technologies for the purpose of betterment of the overall quality of life.

ICAT

ICAT: Institute for Creativity, Arts, and Technology Located at the very crossroads of Virginia Tech and downtown Blacksburg, on the corner of Main Street and Alumni Mall, the Moss Arts Center's facilities provide a community center in the grandest sense, a place where the arts are a catalyst for engagement, inspiration, and discovery. This is also the home of the Instittue for Creativity, Arts, and Technology (ICAT). New facilities complement existing venues, and are located in close proximity to Henderson Hall, Theatre 101, Squires Student Center, the Armory Gallery, and the Lyric Theatre, forming a prominent arts district. The center's 150,000-square-foot facility includes the cutting-edge four-story experimental Cube for performance, immersive environments, installation, and adjacent research studios. Prototyping and multimedia studios provide resources for material exploration and performance. Additional spaces in the Newman Library, including DISIS and DAAS offer supporting curricular spaces equipped with cutting-edge technologies. Jointly with the Center for Human-Computer Interaction (CHCI) and the Creativity + Innovation (C+I), the Institute is in the process of introducing additional educational and community studio spaces in the Media Arts Building.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

Graduate students affiliated with the HCD IGEP may pursue a PhD in one of the home departments of HCD-associated faculty or may elect to apply to the Graduate School's Individualized Interdisciplinary PhD (iPhD) degree program. iPhD students are expected meet all requirements for doctoral study at Virginia Tech, while also being able to craft a unique program of study, uniting multiple disciplines, advisors, and coursework to best satisfy their scholarly interests and career aspirations. Doctoral degrees require 90 credits of graduate course work and research beyond the bachelor's degree. Graduate credits earned in pursuit of a master's degree may be included in the doctoral plan of study if they meet the Graduate School's transfer credit criteria and are approved by the student's advisory committee. For example, students who earned a master's degree at Virginia Tech (minimum of 30 credits) that included coursework and research relevant to their plans for the iPhD would complete another 60 credits for this doctorate. iPhD students who earned a master's degree at another accredited university could transfer up to 50% of the required graded coursework to their iPhD plan of study (required graded coursework could range from 27 to 60 credits). It is expected that iPhD students will be enrolled full time for the duration of their doctoral studies. All students will complete a common core comprising three categories of courses: (1) Overview of interdisciplinary studies, (i.e., GRAD 5134, Topics in Interdisciplinary Studies), (2) Research Methods and Data Analysis and Interpretation, and (3) Scholarly and Professional Ethics. In addition, all iPhD students will complete graduate coursework in relevant disciplinary areas and research and dissertation credits: (4) Disciplinary Studies: list the courses by academic area; total number of credits will vary. The minimum number of graded course credits is 27. See graduate program website for current CORE Disciplinary Study approved cognate courses. (5) Research and Dissertation: the minimum number of research and dissertation credits is 30. Students' iPhD proposals are developed in consultation with their major professor, advisory committee members, and the iPhD Program Director. Proposals are reviewed and approved by the Commission on Graduate and Professional Studies and Policies (CGPSP). The student's advisory committee works with the student to design a plan of study, approves the plan of study, provides advice, conducts required examinations and regularly assesses the student's progress and accomplishments. iPhD students must have an advisory committee of at least four faculty members representing at least two different disciplines. For additional info visit the HCD website. You may also want to contact HCD program co-directors Drs. Ivica Ico Bukvic and Scott McCrickard.

HUMAN DEVELOPMENT

Cynthia Smith, Associate Head
Paul Springer, Head

Emeriti Faculty: Katherine Allen; Joyce Arditti;

Professors: Megan Dolbin-MacNab; Karen Roberto; Laura Sands; Jyoti Savla; Cynthia Smith; Paul Springer; Pamela Teaster;

Associate Professors: Erika Grafsky; Benjamin Katz; Kee Kim;

Assistant Professors: Koeun Choi; Caroline Hornburg; TeKisha Rice; Jody Russon; Caroline Sanner; Rose Wesche;

University Distinguished Professor: Karen Roberto;

Clinical Associate Professors: Jenene Case Pease;

Research Scientists: Isabel Bradburn;

Graduate Contact: martywyatt@vt.edu

Department Website: http://www.hdfs.vt.edu

All graduate programs in the Department of Human Development and Family Science integrate research-based knowledge with human-based values. We promote the quality of life of our society's most basic elements - individuals, families, and communities. We value collaboration, inclusion, equity, empowerment, passion, and celebration in our work. We also embody a lived commitment to the land grant mission of integrating teaching, research, and outreach.

SPECIAL FACILITIES

Students have opportunities to apply knowledge in real-world settings. The Blacksburg campus is home to three such settings: The Child Development Center for Learning and Research, Adult Day Services, and the Family Therapy Center. Graduate students complete course work, internships, practicum, and assistantships related to research, teaching, and outreach at these centers.

Locations, Goals, Specific Research Areas

Locations: Blacksburg The Department of Human Development and Family Science offers programs leading to a master's (M.S.) or doctoral degree (Ph.D.) in Human Development with emphases on childhood and adolescence development (CAD), adult development and aging (ADA), family studies (FS), and marriage and family therapy (MFT). Goals of Facilities and Resources Programs in the Department of Human Development and Family Science integrate research-based knowledge with human-based values. We promote the quality of life of our society's most basic elements - individuals, families, and communities. We value collaboration, inclusion, equity, empowerment, passion, and celebration in our work. We also embody a lived commitment to the land grant mission of integrating teaching, research, and outreach. Distinctive features of our graduate programs include: A commitment to the highest standard of relevance-research, teaching, and outreach that meets real needs of real people; A faculty that is both nationally known and committed to nurturing the best in our students; Opportunities to work closely with faculty and peers on research, journal articles, and professional presentations; Opportunities to apply knowledge in real-world settings. Specific Research Areas Students have opportunities to gain valuable research training working with Human Development and Family Science faculty. A total of 18 areas of research interests are shared among the doctoral faculty including: Adolescence and emerging adulthood Attachment across the lifespan Clinical practice & supervision Cultural diversity Early childhood and intervention Evaluation research Family & couple dynamics Family diversity, LGBTQ, feminism Family dynamics & parenting Gender relations Gerontology & aging studies Health Intergenerational International studies Qualitative methodology Quantitative statistical methodology Sexuality across the life course Social & cultural systems

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The Ph.D. in program areas in Adult Development and Aging (ADA), Child and Adolescent Development (CAD), and Family Studies (FS) at the Blacksburg campus admit students who hold either bachelor's or master's degrees. Bachelor's level students complete the master's thesis and degree en route to the Ph.D. Master's level students can receive transfer credit for related graduate courses. The Marriage and Family Therapy Ph.D. program area at the Blacksburg campus admits students with a master's degree. Students complete a minimum of three years of coursework and one year of internship.Along with required courses, doctoral students participate on research teams, engage in teaching mentorship, and complete a dissertation.Applications are accepted for fall enrollment, and the due date is January 5. GRE scores are no longer required. We join other peer institutions across the country who have eliminated this structural barrier to promote a more equitable, diverse, and inclusive student body.

GRADUATE COURSES (HD)

HD 5005:

Theories in Human Development and Family Science

HD 5005: Individual development and lifespan theories of human development, theory synthesis and construction, application to research. HD 5006: Family, community, and macro systems theories across the lifecourse, theory synthesis and construction, application to research. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5006:

Theories in Human Development and Family Science

HD 5005: Individual development and lifespan theories of human development, theory synthesis and construction, application to research. HD 5006: Family, community, and macro systems theories across the lifecourse, theory synthesis and construction, application to research. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5104:

Adult Development and Aging

Theory and research pertaining to biological/health/daily functioning, cognition, personality, emotional development, and social functioning in the context of diverse families across the life course and life span. Critical life events and supportive environments, policies, and programs. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5114:

Adult Development and Aging II: Interpersonal Issues

Interpersonal and social development across the adult phases of the life cycle. Integration of theory and research as it pertains to family and friend networks, living arrangements, diverse family forms, and critical life events such as widowhood.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5104

Corequisite(s):

HD 5224:

Child Development in the Family Context

Theories of neurobiological, cognitive, emotional, social development, birth to adolescence, in context of families. Critical evaluation, theories

and research methods. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HD 5244:

Sexual Health and Human Rights

Sexual and reproductive health from human development, public health, and critical feminist perspectives, with special attention to human rights issues. Sexually transmitted infections; HIV/AIDS; unintended pregnancy; population policies; eugenics; sexual and reproductive rights; positive sexuality, sex education; and health promotion. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HD 5254 (PHS 5254):

Social Epidemiology and Health Inequities

Social determinants of health through the life-course. Relationship of social injustice to public health. Interplay of major social factors such as poverty, race and gender to influence health domestically and globally. Application of social epidemiology to a range of health outcomes. Inform effective solutions to health inequities. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HD 5324:

Marriage and Family Relationships

Theories in family science research. Family demographics and values. Intimate relationships. Sexuality and gender diversity. Race, ethnic, and social class diversity among families; intersectionality. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HD 5344:

Perspectives On Human Sexuality

Interdisciplinary historical consideration of writings, research, theory, and application of knowledge related to human sexuality.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HD 5404:

Systems Theory and Family Therapy

Theory development and basic underlying assumptions of a systems framework to marriage and family therapy. Emphasis is on conceptualizing human problems as they are related to the functioning of systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HD 5424 (EDCO 5424):

Life Span Human Development

Stages of individual development as they occur in the context of the family life course. Overview of current developmental theories. Impact of race, gender, and class on cultural views of developmental norms.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HD 5434:

Clinical Marriage and Family Therapy I

Underlying philosophy, theory and practice of the Structural and Strategic approaches to marital and family therapy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5404

Corequisite(s):

HD 5444:

Clinical Marriage and Family Therapy II

This course comprises three distinct parts. The first part examines the approaches to family therapy that have been labeled Constructivist Approaches. The second part examines Emotionally Focused Therapy. The final part involves an in-depth look at the Metaframeworks Model developed at the Institute for Juvenile Research in Chicago, which integrates various schools of marriage and family therapy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5404

Corequisite(s):

HD 5454:

Clinical Marriage and Family Therapy III

Emphasis is on interrelationships between mind, body, environment, and social aspects of behavior in the context of the family system. The focus will be on the process of diagnosis and treatment in the family context.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5404, HD 5434, HD 5444

Corequisite(s):

HD 5474:

Professional Seminar In Marriage and Family Therapy

Focuses on the major ethical, legal, and professional issues faced by those in the field of marriage and family therapy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5484:

Clinical Marriage and Family Therapy IV

Issues of treatment related to specialized content areas of family therapy. Focus on topics such as: sexual dysfunction, divorce counseling and mediation, the abusive/violent family, addicted family members, suicidal problems, ethical and professional issues in treating marriages and families.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5434, HD 5444

Corequisite(s):

HD 5514:

Research Methods

Introductory course in research methodology for the social sciences: formulation of a research problem, design, sampling, data collection, measurement, data analysis, interpretation, and writing the research report.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5524:

Qualitative Methods in HDFS

Design, conduct, and evaluate qualitative research concerning human development and families. Examines diverse traditions of qualitative research and methods of data collection, interpretation, analysis, and representation, and ethical and practical complexities. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5644:

Program Development and Evaluation in Human Development

Methods of conducting program evaluations for prevention and intervention programs that promote public health and human development. Major dimensions of evaluation strategies, including process evaluation, impact assessment, and cost analysis. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5614, HD 5624, EDRE 5404

Corequisite(s):

HD 5654:

Grant Development and Administration in Human Development

Overview of the methods and procedures for developing competitive grant proposals. Students learn basic grant writing skills that include identifying and seeking funding sources, preparing a fundable grant proposal, building a budget, and managing a funded project. Portfolio project: Development of actual grant proposal for an organization or special project.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5614, HD 5624, EDRE 5404

Corequisite(s):

HD 5664:

Internship in Human Development

Provides consultation and seminar dialogue for advanced masters student in Human Development as they undertake experiences in a supervised field setting. Possible settings span an array of human development agencies focused on children, adults, and families. Experiences include activities of a regularly employed professional in the setting accompanied by periodic seminar meetings.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5634, HD 5644, HD 5654, EDRE 5404

Corequisite(s):

HD 5714:

Current Topics in Human Development

Advanced seminar on current topics in human development. May be repeated with different topic content for a maximum of 9 credits. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5724:

Couples Therapy

Overview of the conceptual, clinical, and empirical advances in couples therapy. Focus of course will be on using current research on couple interaction and evidence-based marital therapy to assess and treat couples.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5404

Corequisite(s):

HD 5734:

Marriage and Family Therapy Techniques

This course introduces the student to the requisite skills for beginning practicum. Students will examine the role of theory in practice, the differences between process and content, the use of process in clinical work, and the impact of gender, ethnicity, and therapists self perception on the therapy process. The course will also review nuts and bolts of therapy (i.e., writing appropriate clinical notes, identifying risk issues, etc.). Admission to the MFT Clinical Program is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5404, HD 5434

Corequisite(s):

HD 5744:

Special Topics in MFT

In-depth study of selected topics in marriage and family therapy (e.g., medical family therapy, play therapy, spirituality and family therapy). Focus of course will be on reviewing current research on the specific issue and developing treatment strategies for individuals, couples, and families. May be repeated for credit with different content for a maximum of 9 credit hours. For Northern Virginia Students Only.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5404

Corequisite(s):

HD 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5964:

Practicum

Practicum experiences in departmental options under supervision. (Maximum 15 percent of students graduate program). Repeatable with different topics.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

HD 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 5994:

Research And Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HD 6004:

Prof Development Seminar

Review and critique of professional issues in the field of human development related to research and scholarship, pedagogy, outreach, and service. May be repeated.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 6214:

Parent-Child Interaction

Review of theories and research in parent-child interaction from birth through adolescence and exploration of practical application in various settings.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 6414:

Advanced Traditional Models In Marriage and Family Therapy

Advanced study and application of Systemic, Bowenian, and Narrative family therapy models within the profession of marriage and family therapy. Prior training in general systems theory, family therapy theories, and therapeutic experience in family therapy required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 6404

Corequisite(s):

HD 6444:

Advanced Contemporary Marriage and Family Therapy

Advanced study of the profession of marriage and family therapy. This course will rotate topics and cover two advanced practice areas such as feminist therapy, sex therapy, or therapy with families with substance abuse or violence.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 6414, HD 6424, HD 6404

Corequisite(s):

HD 6464:

Clinical Supervision of Marriage and Family Therapy

Underlying philosophy, theory, and principles of the process of supervising the practice of marriage and family therapy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 6404, HD 6414, HD 6424

Corequisite(s):

HD 6484:

Marriage and Family Therapy Research

Comprehensive overview of the major empirical research of marriage and family therapy. Prior training in family therapy theories and therapeutic processes required. A basic knowledge of quantitative and qualitative research methods required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 6514:

Adv Research Methods

Advanced level research methodology; examination of current procedures for studying individual development and family relationships.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HD 5514

Corequisite(s):

HD 6524:

Current Topics in Advanced Research Methods

Discussions on emergent techniques used in contemporary methodological literature. Training in modern software for implementation of complex research methodologies. May be repeated with different topic content for a maximum of 4 credits. Pre: Graduate standing.

Credit Hour(s): 1 TO 4

Lecture Hour(s): 1 TO 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HD 7994:

Research And Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HUMAN NUTRITION, FOODS, AND EXERCISE

Stella Volpe, Head

Professors: Brenda Davy; Kevin Davy; Dawnine Larson-Meyer; Dongmin Liu; Eva Schmelz; Elena Serrano; Stella Volpe; Jay Williams;

Associate Professors: Deborah Good; Robert Grange; Samantha Harden; Young Ju; Vivica Kraak;

Assistant Professors: Julia Basso; Siobhan Craige; Alexandra DiFeliceantonio; Joshua Drake; Valisa Hedrick; Carlin Rafie; So Ra Shin; Jeffrey Stein;

Research Assistant Professors: Sarah Misyak;

General Contact: hnfegrads@vt.edu

HNFE Graduate website: https://www.hnfe.vt.edu/graduate.html

MSND Graduate website: https://www.hnfe.vt.edu/graduate/MSnutrition.html

Our mission is to discover, translate, and disseminate health-related advances in the nutrition, food, and exercise sciences. The work of the faculty and graduate students in the Department of Human Nutrition, Foods and Exercise (HNFE) contributes significantly to scientific progress through molecular and clinical advances leading to prevention and improved treatment of obesity and chronic diseases; behavioral discoveries that lead to effective intervention programs for youth and adults; and interdisciplinary research teams who speed the translation of scientific discoveries to effective therapeutic and public health interventions that will benefit Virginians and the nation. We provide exceptional training for our students focusing on the preparation of future professionals who are knowledgeable, committed to life-long learning, ethical, culturally sensitive, and able to work collaboratively as well as independently. Training in the use of rigorous scientific inquiry is the cornerstone of the HNFE graduate program. We foster innovation across all three Virginia Tech missions areas - teaching, research, and outreach - by (1) supporting programs that promote sustainability and community viability and encouraging student participation in research and extension; (2) designing, developing, and implementing programs and policies through a participatory and shared effort between the HNFE research and teaching community; and (3) utilizing our teaching and research expertise to improve the health across diverse populations. Finally, the department's main focus is on addressing one of the most critical public health challenges of today - chronic disease.

SPECIAL FACILITIES

The Department of Human Nutrition, Foods and Exercise is just one facet of a large and vibrant life science research enterprise at Virginia Tech. Our faculty study a range of health issues using cutting edge research equipment and facilities. Laboratory facilities available to support graduate student research include: molecular nutrition laboratories, muscle function and metabolism laboratories, small animal care facilities, a clinical research laboratory including a comprehensive body composition laboratory and an exercise-testing laboratory, a metabolic kitchen, two foods laboratories including a sensory evaluation facility, and the implementation and systems science laboratory. The Department also places considerable effort on generating and disseminating research findings. HNFE faculty are intimately involved in two Interdisciplinary Graduate Education Programs (IGEP) with the goal of promoting and sustaining interdisciplinary graduate education and research at Virginia Tech. The Translational Obesity Research IGEP is drawing faculty and students from diverse disciplines together to form integrative research teams with a central focus on translational obesity research, spanning from “cells to society” (i.e., from basic science to practice, policy and practice implementation; or type 1 to 4 research translation). Faculty and graduate students from the departments of HNFE, Agricultural and Applied Economics, Communication, Human Development, and Psychology are working together to cross traditional boundaries and conduct innovative translational obesity research. The Water INTERface IGEP spans Engineering, Science, and Human Health, and is united by a central focus of "Water for Health", spanning from "pipes to people". This IGEP includes graduate students and faculty from HNFE, Food Science and Technology, Biological Sciences, and Civil and Environmental Engineering to address technical and societal challenges of transforming low-quality water resources into clean water for healthy living, and to promote water consumption for optimal health. The HNFE faculty enjoys strong collegial relationships with individuals of similar interests in other departments within the College of Agriculture and Life Sciences, such as the Biochemistry, Animal and Poultry Sciences, Food Science and Technology, as well as departments from the Colleges of Veterinary Medicine, Science, and Liberal Arts and Human Sciences. HNFE also collaborates with the Virginia Tech Carilion School of Medicine, the Virginia Tech Carilion Research Institute, and Carilion Clinic Departments of Pediatrics, Family Medicine, and Research. There are strong ties with the Student Health Center, statewide and national food and nutrition programs, and community agencies and health care facilities in the Blacksburg, Roanoke, and surrounding areas. The department faculty members are committed to the individual mentoring of each student. A faculty member usually has no more than four to six graduate students, allowing time for careful attention to each. Students also get to know faculty and other graduate students who serve as informal mentors through graduate classes and attendance at department seminars or other informal research presentations. HNFEs partnership with Virginia Tech Carilion Research Institute and Carilion Clinic has resulted in the Center for Transformative Research on Health Behaviors located at Fralin Biomedical Research Institute in Roanoke, conducts transformative health behaviors research with the primary objectives of prevention and treatment of lifestyle related disease.

Facilities

The Department of Human Nutrition, Foods, and Exercise (https://www.hnfe.vt.edu/) occupies space in Wallace Hall, War Memorial Hall, the Integrated Life Sciences Building at the Corporate Research Center, and the Fralin Biomedical Research Institute in Roanoke. Wallace Hall contains The Laboratory for Eating Behaviors and Weight Management, The Dietary Assessment laboratory, and the Metabolic Kitchen. The Food and Nutrition Policy Group is also located in Wallace Hall. The Integrated Life Sciences Building (ILSB) houses researchers from diverse backgrounds including, but not limited to, virology, biology, nutritional biochemistry, genetics, foods science, and behavioral science. The Molecular Nutrition, Muscle Function, and Muscle Metabolism laboratories can be found here as well as groups working on the molecular aspects of health, nutrition, and disease, including genetic determinants of obesity and the prevention of cancer, diabetes, and hypertension. This research is performed in laboratories equipped with modern molecular and cell biology instruments and tools for cellular and animal research. The building also houses equipment for the metabolic phenotyping core that allows for determination of body composition, whole body energy metabolism, glucose and insulin tolerance, analysis of metabolites, and more. Furthermore, core facilities for quantitative real-time PCR, cell culture, radio-labeled substrate metabolism, mitochondrial function, histology, confocal microscopy, and flow cytometry are also located in the building. Center for Transformative Research on Health Behaviors (https://ctrhb.vtc.vt.edu/) located in VT Riverside in Roanoke conducts transformative health behaviors research with the primary objectives of prevention and treatment of life-style related diseases. Fralin Biomedical Research Institute in Roanoke houses additional space for clinical and behavioral scientists for clinical and community research. The space includes equipment to assess body composition, energy metabolism, and other clinical assessments. There is also space for conducting clinical and community based interventions and programs. War Memorial Hall houses The Human Integrative Physiology laboratory and provides the infrastructure for clinical studies requiring measurements of cardiovascular structure and function, submaximal and maximal exercise performance, body composition (DEXA), resting and exercise energy expenditure and substrate metabolism, and collection and processing of tissue and blood samples.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

The M.S. in Nutrition and Dietetics program offers a professionally-oriented, competency-based curriculum which integrates didactic coursework and supervised experiential learning (SEL) opportunities in a variety of settings in order to prepare future nutrition and dietetics practitioners to become leaders in a rapidly evolving field. The advanced coursework provided through the graduate degree will allow students to master skills in the application of critical thinking, evidence-based practice, and communication with emphasis on nutrition counseling for behavior change. Students will also gain an appreciation for the impact of interprofessional teamwork, advocacy, service, and leadership in shaping the future of the dietetics profession. In order to earn a Master of Science in Nutrition and Dietetics diploma, the student must a) complete all courses with a grade of “B-” or higher; and b) receive a passing grade for all Supervised Experiential Learning (SEL) rotations (HNFE 5754: Internship in HNFE). Students must also maintain an overall GPA of 3.0 on a 4.0 scale and demonstrate a “competent” level or higher on all ACEND summative competency evaluations. Successful completion of both the Master of Science in Nutrition and Dietetics degree program and demonstration of all ACEND competencies results in the conferral of a Master’s degree and issuance of an ACEND verification statement resulting in eligibility to take the Registration Examination for Dietitians through the Commission on Dietetics Registration (CDR). The M.S. in Nutrition and Dietetics program consists of the following Virginia Tech courses: HNFE 5125G Advanced Medical Nutrition Therapy I (3 credits) HNFE 5126G Advanced Medical Nutrition Therapy II (3 credits) HNFE 5154 Research Methods in Nutrition and Physical Activity (3 credits) HNFE 5314 Business of Dietetics and Healthcare (3 credits) EDCO 5214 Theories of Counseling and Consultation (3 credits) HNFE 5344 Nutrition Counseling for Behavior Change (3 credits) HNFE 5354 Food for Optimal Health (3 credits) HNFE 5324 Public Health Nutrition Policies and Programs (3 credits) HNFE 5334 Clinical Nutrition Care Applications (2 credits) HNFE 5304 Principles of Dietetics and Nutrition Practice (2 credits) HNFE 5394 Professional Practice in Nutrition and Dietetics (1 credit) Choice elective (3 credits) HNFE 5754 Internship in Human Nutrition, Foods, and Exercise: Clinical SEL (10 credits) Community SEL (5 credits) Foodservice Management SEL (3 credits) Dietetics and Professional Management SEL (2 credits) Total credits: 51 All graduate-level courses must be taken at Virginia Tech. 51 credits are required to graduate.

MS Degree

TOEFL

iBT: Total (90.0), Listening Subsection (20.0), Writing Subsection (20.0), Speaking Subsection (20.0), Reading Subsection (20.0)

IELTS (International English Language Testing System)

IELTS: Total (6.5)

The Department of Human Nutrition, Foods and Exercise offers a thesis-based Master's degree in one of three focus areas: Molecular and Cellular Science, Clinical Physiology and Metabolism, and Behavioral and Community Science. The minimum requirements for the MS degree are 30 graduate credit hours of which at least 20 credit hours must be graded course work (12 credit hours of 5000-level or higher) and at least 6 credit hours must be thesis research. The Department requires MS students to complete Translational Science in Human Nutrition, Foods and Exercise (HNFE 5204) and 3 credit hours of statistics. Students are also required to complete Ethics and Integrity and Diversity and Inclusion Training. See departmental website for more information. https://www.hnfe.vt.edu/programs/graduate.html Accelerated Undergraduate/Graduate Degree (BS/MS) Seniors in a Virginia Tech bachelor's degree program, who have a GPA of 3.4 or better, may be eligible for an Accelerated Master’s Degree in HNFE. Students must apply to the Graduate School for a Master's degree and submit the Accelerated Undergraduate/Graduate Degree and Course Designation Form to the Graduate School before the start of their senior year. The minimum requirements for the BS/ MS degree are the same as the Master's degree and 30 graduate credits of which at least 20 credits must be graded course work (12 credits of 5000-level or higher) and at least 6 credits must be thesis research credit hours. The Department requires MS students to complete Translational Science in Human Nutrition, Foods and Exercise (HNFE 5204) and 3 credit hours of statistics. Students are also required to complete Ethics and Integrity and Diversity and Inclusion Training. See departmental website for more information.Students in this program may also apply for Dual Status during the final year of their undergraduate degree program. This allows students to obtain graduate credit during their senior year. See departmental website for more information. https://www.hnfe.vt.edu/programs/graduate.html

PhD Degree

TOEFL

iBT: Total (90.0), Listening Subsection (20.0), Writing Subsection (20.0), Reading Subsection (20.0), Speaking Subsection (20.0)

IELTS (International English Language Testing System)

IELTS: Total (6.5)

The Department of Human Nutrition, Foods and Exercise offers doctoral degrees in one of three focus areas: Molecular and Cellular Science, Clinical Physiology and Metabolism, and Behavioral and Community Science. The minimal requirements for the doctoral degree are 90 graduate credit hours of which at least 27 credit hours are based on graded course work (21 credit hours of 5000-level or higher) and at least 30 credit hours of dissertation research. The Department requires PhD students to complete Translational Science in Human Nutrition, Foods and Exercise (HNFE 5204) and 6 credit hours of statistics. Students are also required to complete Ethics and Integrity and Diversity and Inclusion Training. See departmental website for more information. https://www.hnfe.vt.edu/programs/graduate.html

MSND Degree

Offered In (Blacksburg)

The M.S. in Nutrition and Dietetics program offers a professionally-oriented, competency-based curriculum which integrates didactic coursework and supervised experiential learning (SEL) opportunities in a variety of settings in order to prepare future nutrition and dietetics practitioners to become leaders in a rapidly evolving field. The advanced coursework provided through the graduate degree will allow students to master skills in the application of critical thinking, evidence-based practice, and communication with emphasis on nutrition counseling for behavior change. Students will also gain an appreciation for the impact of interprofessional teamwork, advocacy, service, and leadership in shaping the future of the dietetics profession. In order to earn a Master of Science in Nutrition and Dietetics diploma, the student must a) complete all courses with a grade of “B-” or higher; and b) receive a passing grade for all Supervised Experiential Learning (SEL) rotations (HNFE 5754: Internship in HNFE). Students must also maintain an overall GPA of 3.0 on a 4.0 scale and demonstrate a “competent” level or higher on all ACEND summative competency evaluations. Successful completion of both the Master of Science in Nutrition and Dietetics degree program and demonstration of all ACEND competencies results in the conferral of a Master’s degree and issuance of an ACEND verification statement resulting in eligibility to take the Registration Examination for Dietitians through the Commission on Dietetics Registration (CDR). The M.S. in Nutrition and Dietetics program consists of the following Virginia Tech courses: HNFE 5125G Advanced Medical Nutrition Therapy I (3 credits) HNFE 5126G Advanced Medical Nutrition Therapy II (3 credits) HNFE 5154 Research Methods in Nutrition and Physical Activity (3 credits) HNFE 5314 Business of Dietetics and Healthcare (3 credits) EDCO 5214 Theories of Counseling and Consultation (3 credits) HNFE 5344 Nutrition Counseling for Behavior Change (3 credits) HNFE 5354 Food for Optimal Health (3 credits) HNFE 5324 Public Health Nutrition Policies and Programs (3 credits) HNFE 5334 Clinical Nutrition Care Applications (2 credits) HNFE

5304 Principles of Dietetics and Nutrition Practice (2 credits) HNFE 5394 Professional Practice in Nutrition and Dietetics (1 credit) Choice elective (3 credits) HNFE 5754 Internship in Human Nutrition, Foods, and Exercise: Clinical SEL (10 credits) Community SEL (5 credits) Foodservice Management SEL (3 credits) Dietetics and Professional Management SEL (2 credits) Total credits: 51 All graduate-level courses must be taken at Virginia Tech. 51 credits are required to graduate.

GRADUATE COURSES (HNFE)

HNFE 5044:

Seminar in Human Nutrition and Foods

Critical review and oral reporting of pertinent literature and research in the various areas of foods and nutrition.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5114G:

Advanced Food and Nutritional Toxicology

Principles of food and nutritional toxicology with primary emphasis on food components and food toxins including absorption, metabolism and excretion. An overview of types of adverse food reactions including food allergy, food sensitivity, and food intolerance. An overview of U.S. and international laws and regulation of safety assessment of foods including food additives, dietary supplements, and residues of contaminants, pesticides, and antibiotics. Analysis of food and nutritional toxicity cases in the context of the food system, regulatory policies, and public communication. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5124:

Dissemination and Implementation Science: Bridging Research and Practice

Historical, theoretical, process and outcome models to guide the dissemination and implementation of evidence-based interventions in community, clinical, and business (or worksite) settings. Application of conceptual models and methods to leverage systems (including, but not limited to, the resources, mission, values) in order to implement or de-implement interventions. Communication of dissemination key measures and constructs, and how to serve as an applied science team member; especially valuing research-practice partnerships and stakeholder needs and values. Experiential and application focus. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5125G:

Adv Medical Nutrition Therapy

Study of nutritional diagnostic, therapeutic and counseling services provided by a registered dietitian. Emphasis on the relationship between principles of nutritional care and the medical treatment of individuals with selected diseases or clinical problems. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5126G:

Adv Medical Nutrition Therapy

Study of nutritional diagnostic, therapeutric and counseling services provided by a registered dietitian. Integration of knowledge of pathophysiology, biochemical, and clinical parameters, medical treatment and nutrition therapy for patients with selected clinical problems/disease states.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HNFE 5125G

Corequisite(s):

HNFE 5144:

Molecular Aspects of Nutrition and Disease

The role of specific nutrients in human and animal health at a physiologic and molecular level. Emphasis is placed on the influence of nutrients on gene expression especially with regard to pathophysiology of diseases. Physiological and molecular aspects of nutrition and immune function will also be discussed.

Credit Hour(s): 3

Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): BCHM 5124, (ALS 5104 OR HNFE 5104)
Corequisite(s):

HNFE 5154:

Research Methods in Nutrition and Physical Activity

Research evaluation and design for clinical and behavioral research with an emphasis on diet and physical activity assessment and intervention. Methods applicable to studies designed to test interventions, programs, and practices that target the end result of dietary and physical activity behavior change are emphasized. Research ethics. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5164:

Molecular Aspects of Diet and Cancer

Molecular and genetic/epigenetic factors in human cancer development. Cellular and molecular targets of the diet or specific nutrients in cancer prevention. Interaction of diet, obesity, and body weight on cancer. Dietary strategies targeting the tumor microenvironment and systemic contributors to tumor progression. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5174:

Nutrition for Sport & Exercise

Nutritional requirements for the well-being and optimal performance of athletes of various ages and for various sports. Methods of assessment and modification of diet, energy expenditure, performance, and body composition in athletes. Nutritional strategies for athletes based on sport and goals. Evaluation of ergogenic aids and dietary supplements for performance and body composition. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5174G:

Advanced Nutrition and Physical Performance

Nutritional requirements for the well-being and optimal performance of athletes. Methods of assessment and modification of diet, performance, and body composition in athletes. Evaluation of dietary ergogenic aids and supplements for performance and body composition. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5184:

Advanced Macronutrient Metabolism

Macronutrients sources, interrelationships, and factors affecting utilization, metabolism, physiological, and biochemical function to provide energy. Dietary carbohydrate (simple and complex), fat, and protein metabolism following a meal, during fasting conditions, and during and after exercise or physical activity, for energy generation. Altered metabolism of dietary carbohydrates, fats, proteins, and alcohol in metabolic diseases including obesity and diabetes. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5194:

Diet Suppl Health

Practical and fundamental aspects of widely used dietary and herbal supplements, including micronutrients, macronutrients, prebiotics, probiotics, plant extracts, and bioactive compounds. Efficacy and mechanism of dietary and herbal supplements in weight management, health promotion, and disease prevention. Interaction of dietary supplements with gut microbiome. Safety and regulatory considerations for the use of dietary supplements. Focused literature review and project development. Pre: Graduate Standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5204:

Translational Science in HNFE

Principles and practice of translational science research as it relates to human health and chronic disease. Overview of basic science research, preclinical and clinical intervention development, and community and public health practice in relation to human nutrition, foods, and exercise Principles of scientific inquiry from a team-based approach. Scientific team development and generation of interdisciplinary and translational research questions. Pre: Graduate Standing.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5214:

Physical Activity and Health

Practical applications of interventions for health promotion, disease prevention, and treatment in diverse adult populations. Implications of sedentary behavior. Physiological adaptations to exercise and physical activity, and fitness training principles. Exercise is Medicine initiative principles and health behavior change theories. Health assessment, exercise testing, and prescription. Historical evaluation and application of guidelines for healthy and diseased populations. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

HNFE 5304:

Principles of Dietetics and Nutrition Practice

Orientation to the Registered Dietitian Nutritionist (RDN) profession. Diverse practice roles and resources to support professional development. Introduction and assessment of concepts key to successful practice as an RDN (leadership strengths, continued professional development planning, code of ethics, standards of practice, effective communication and nutrition informatics). Strategies to influence the profession, the workplace and current food and nutrition policy issues. Pre: Graduate Standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5314:

Business of Dietetics and Healthcare

Business and management skills and perspectives for Registered Dietitian Nutritionists. Private practice and entrepreneurial strategies in nutrition and dietetics. Public relations messaging. Healthcare administration, federal and state regulations, and policy and impact on the dietetics profession. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5324:

Public Health Nutrition Policies and Programs

Public health, health promotion, food and nutrition policy and population-based nutrition principles in the United States (U.S.) and globally. Factors that contribute to nutrition-related health disparities and chronic diseases. Community and population-based nutrition assessment for vulnerable populations. Food policy and program development, implementation, monitoring and evaluation to promote healthy, resilient and sustainable food environments. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5334:

Clinical Nutrition Care Applications

Application of the nutrition care process including patient screening and clinical assessment (patient interviewing, anthropometrics measurements, nutrition-focused physical exam, energy and nutrient needs, laboratory values and other diagnostic tests, physical activity). Consideration of assessments implication on development nutritional diagnosis and individualized intervention plan. Monitoring and evaluating impact of nutritional care. Exposure to diverse patient types using case-based, simulation and other experiential learning. Effective communication of nutrition care plan to healthcare team members.

Credit Hour(s): 2

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HNFE 5126G

Corequisite(s):

HNFE 5344:

Nutrition Counseling for Behavior Change

Practical application of behavior change theories, counseling techniques, and communication skills for nutrition-related behavior change of individuals and groups. Application of self-evaluation, quality improvement, and professional code of ethics. Counseling practice based on nutrition care process, evidence-based practices, counseling ethics, client-centered approaches, health literacy, and cultural competence. Effective communication in a counseling setting. Interdisciplinary teamwork for refining counseling skills and client outcomes. (2H, 3L, 3C)

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): EDCO 5214

Corequisite(s): HNFE 5126G

HNFE 5354:

Food for Optimal Health

Diet and menu planning and management logistics for Registered Dietitian Nutritionists to support health and disease management for diverse populations. Application of food safety principles and methods of microbial control while managing the flow of food in health-care, non-profit, and research environments. Recipe, menu, and diet design, analysis, and production based on principles of food chemistry, human health, federal regulation of food, globalized agricultural processes, and environmental sustainability. Translation of food for health messages to target audiences.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): HNFE 5126G

Corequisite(s):

HNFE 5364:

Sports Nutrition Applications

Applied sports nutrition tools and strategies. Practical evaluation and consumer education of sports foods and beverages, sports nutrition tools, and dietary trends. Evidence-based practice for working with special athlete populations and those exercising in extreme environments, conditions, and sports. Sports medical nutrition therapy for athletes with a variety of health conditions or disease states.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): HNFE 5125G, HNFE 5174G

Corequisite(s): null null

HNFE 5374:

Sports Nutrition Practicum

Practical sports nutrition work in a community setting. Experiential sports nutrition education and counseling with a focus on enhancing performance, health, and well-being. Ethics, regulations, legislation, and standards of professional practice in sports nutrition planning, care, and programs.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): HNFE 5174G

Corequisite(s):

HNFE 5384:

Research Dietetics Practicum

Application of research concepts and guidelines to practical work in nutrition-related research analysis and interpretation. Experiential research project development, implementation, and evaluation. Analyze and interpret research data. Protocol development and project quality control. Standards of professionalism and ethical research practice in nutrition research. Self-evaluation of practicum activities.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): HNFE 5154, HNFE 5204

Corequisite(s):

HNFE 5394:

Prof Pract Nutrition Dietetics

Final preparation for entering Registered Dietitian Nutritionist (RDN) profession. Assessment and development of entry-level professional strengths in leadership, communication, nutrition informatics, and advocacy. Job search strategies, interprofessional responsibilities, and continuing professional development planning for career and practice

advancement. Performance strategies for upholding code of ethics and standards of professional practice. Application of mentoring approaches. Dissemination of practice-based research to various audiences.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): HNFE 5304
Corequisite(s):

HNFE 5424:

Obesity and Weight Management

Foundational knowledge addressing the prevalence, consequences, mechanisms and pathophysiology of obesity and related conditions. Guidelines for weight management, and for the prevention and management of obesity in pediatric (i.e., infancy through adolescence) and adult populations. Special populations including athletes, older adults, bariatric surgery patients, and individuals with eating disorders. Current research addressing popular diets, treatments, and trends. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5434:

Applications in Weight Management Practice

Applied medical nutrition therapy for adult and pediatric (i.e., infancy through adolescence) weight management practice. Assess, evaluate, and monitor weight and nutritional status of patients experiencing various diseases and medical conditions. Evidence-based strategies for working with special populations including athletes, older adults, and individuals with eating disorders. Individual and group weight management counseling practice. Evaluation of and consumer education in popular diets and trends.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): HNFE 5126G, HNFE 5424
Corequisite(s):

HNFE 5444:

Weight Management Practicum

Practical work in weight management in clinical and community environments. Experiential pediatric (i.e., infancy through adolescence) and/or adult weight management medical nutrition therapy intervention development, implementation, evaluation, and monitoring. Standards of professionalism and ethical practice in clinical and community settings.
Credit Hour(s): 3
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s): HNFE 5344, HNFE 5434
Corequisite(s):

HNFE 5454:

Nutrition and Disease Prevention Through the Life Cycle

Role of diet in health promotion and disease prevention at all stages of the life cycle. Etiology of major nutrition-related health problems. Population-level dietary nutrient requirements and dietary guidelines. Patterns in the US. Diet-related health promotion and disease prevention strategies. Pre: Graduate standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5474:

Human Exercise Testing: Physiology and Biomechanics

Mechanisms for acute and chronic physiological adaptations to exercise and muscle contraction. Interactions between physiology and biomechanics as it pertains to research outcomes. Principles of exercise and biomechanics testing for research purposes, safety considerations, factors that affect test results, and criteria to terminate tests. Research study design and methodology for specific research goals. Pre-participation screening and risk classification for exercise and biomechanics testing. Assessment of body composition, endurance, strength, power, fatigue, and flexibility. Interpretation of exercise tests. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5604:

Principles of Public Health Nutrition

This course provides knowledge of community assessment, planning,

implementation, and evaluation as related to nutrition services in health programs. It presents a conceptual background for viewing dietary as well as social, economic, and environmental factors influencing health and nutritional status of populations. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): HNFE 4624, HNFE 5654
Corequisite(s):

HNFE 5644G:

Advanced Health Counseling

Roles, responsibilities, legal requirements and scope of the health professional. Interviewing, counseling, education, health promotion and behavior change strategies for diverse populations. Guidance and referral, health assessment, communication skills, and problem-solving. Application of counseling techniques such as goal-setting, ethical practice, cultural competence, evidence-based practice. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5684 (PHS 5214):

Program Development in Health Education

Theory, trends, and design of community health education programs implemented in communities, health agencies, hospitals, and industry. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5694 (PHS 5044):

Public Health Policy and Administration

Multiple dimensions of the health policy-making process including the roles of ethics and evidence. Analyzing health polices for their impact on public health and health equity. Examining the structure and function of health care models nationally and globally. Constitutional basis for public health. Applying principles of planning, organizing, directing, staffing, and budgeting to public health agencies. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5754:

Internship in Human Nutrition and Foods

Student participation in a planned clinical experience under supervision of a university staff member in an appropriate work center. (Maximum 12C). Consent required.
Credit Hour(s): 1 TO 12
Lecture Hour(s): 1 TO 12
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5764:

Externship in Human Nutrition and Foods

Special interdisciplinary problem-solving clinics for experienced health practitioners who are engaged part-time in graduate study while continuing in positions of leadership in health organization. (Maximum 12C). Consent required.
Credit Hour(s): 1 TO 12
Lecture Hour(s): 1 TO 12
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5804:

Exercise Physiology

Molecular and cellular mechanisms underlying physiological adaptations to acute and chronic exercise training. Physiological basis for current physical activity guidelines. Influences of physical activity on promotion of health and prevention and treatment of chronic diseases. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HNFE 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5964:

Field Work/Practicum

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

HNFE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

HNFE 6064:

Advanced Topics in Human Nutrition, Foods and Exercise

Critically evaluate and discuss contemporary and/or ongoing controversial issues in human nutrition, foods and exercise. May be repeated with different content for a maximum of 12 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 6234 (ALCE 6234):

Theory & Practice of Community-Based Participatory Research

The theory and practice of Community-based Participatory Research (CBPR). Empirical examples from community development, agriculture and food systems, community health, and human nutrition. Principles of CBPR, practical and ethical issues in collaborating with communities, participatory action methods, and approaches to evaluation. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

INDIVIDUAL INTERDISCIPLINARY PHD

Aimee Surprenant, Head

General Contact: wrhuckle@vt.edu

Interdisciplinary graduate Education:

https://graduateschool.vt.edu/academics/programs/interdisciplinary-graduate-education/individualized-phd-program.html

The Individual Interdisciplinary Doctoral Program (IPhD) is designed to prepare exceptional graduate students who wish to pursue and attain an individually customized interdisciplinary doctoral degree. The purpose of the IPhD is to provide an option for highly qualified students whose educational goals are uniquely interdisciplinary and cannot optimally be met by a single discipline or degree-granting academic unit at Virginia Tech. The IPhD offers a distinctive opportunity for students seeking a breadth of knowledge, in addition to disciplinary depth, not available within one discipline.

SPECIAL FACILITIES

The IPhD program is housed in the Graduate School located in the Graduate Life Center. Additional facilities may be available depending on those available to the advisory committee members.

Graduate Life Center

The IPhD is housed administratively in the Graduate Life Center. Facilities available to IPhD students will depend on those available to the advisory committee members and the nature of the research.

DEGREES OFFERED

PhD Degree

The Graduate School offers the individualized interdisciplinary PhD (IPhD) program for highly motivated students in excellent academic standing whose primary education and research goals are truly interdisciplinary and not readily accommodated by a single existing discipline. The IPhD program is specifically designed for students who seek to study across two or more disciplines in a combination not available through a conventional degree-granting program. For successful admission to and completion of the IPhD program at Virginia Tech, the student must demonstrate the need for an interdisciplinary research program and identify a major professor and advisory committee members who will provide the appropriate guidance. The composition of the advisory committee should reflect the particular academic disciplines and realms of expertise being united by the IPhD program, but typically stems from the student's original programmatic affiliation(s). In identifying potential advisors and areas of study, prospective IPhD students may elect to craft a wholly unique degree focus and advisory team. or may affiliate with faculty participants in an existing Interdisciplinary Graduate Education Program (IGEP). For applicants to the IPhD program who are not currently enrolled as graduate students at Virginia Tech, it is essential first to identify a major professor and advisory committee members willing and able to serve in these capacities. Typically, this step will necessitate a visit to campus or extensive exploration by phone or email. Admission to the IPhD is highly selective. The Graduate School will expect completion of an especially rigorous set of courses and dissertation research project for this degree. Applicants most competitive for entry into an IPhD program are those nearing completion or having completed a master's degree. Prospective students without a master's degree may be approved by the Dean of the Graduate School to submit an application under special circumstances. Because of the rigor and intensity of the IPhD program, a graduate GPA of 3.5 or higher is required. Students currently enrolled in a graduate degree program at Virginia Tech who are interested in the IPhD are encouraged to apply as early as possible in their program, to maximize the duration of their unique interdisciplinary training experience. Prospective IPhD students should contact Bill Huckle, Associate Dean and Director of Interdisciplinary Graduate Education by email (wrhuckle@vt.edu) for information and guidance in preparing the IPhD application. Candidates will prepare their application, including a program of study and dissertation proposal, in consultation with the major advisor, the advisory committee members, and the Graduate School. Formal applications for admission to the IPhD program are submitted to the Graduate School and are evaluated on a rolling basis. Once admitted, students can start their IPhD program in Fall, Spring, or Summer terms. The Commission on Graduate and Professional Studies and Policies (CGPSP) serves as the IPhD admissions committee and reviews applications during their twice-monthly meetings throughout the academic year. Application deadlines are somewhat flexible but reflect the extensive time needed for proposal preparation and review. Application materials include the following: Results of standardized tests such as GRE or GMAT, if required by the academic units with which the student principally will be working. For international students, acceptable TOEFL (iBT at least 80 total and 20 on each subtest) or IELTS (6.5) scores. Other credentials can satisfy Graduate School requirements for competency in English (e.g., earned a degree from an international university that provides all instruction in English). A letter from a Virginia Tech faculty member identified as the student's IPhD program advisor, describing the student's potential for success and ability to conduct independent interdisciplinary research, and expressing willingness to chair the student's advisory committee. Letters or email messages from three or four VT faculty members willing and qualified to serve on the student's advisory committee. The committee should be comprised of faculty representing at least two colleges. For new applicants, three letters of recommendation from faculty commenting on the student's ability to pursue an interdisciplinary doctoral degree For new applicants, at least one example of scholarly writing (e.g., introduction and conclusion of master's thesis, published research paper) Student's statement of career goals and rationale for pursuing the IPhD degree. An IPhD degree proposal document, not to exceed 20 pages in length and written with a general, interdisciplinary academic audience in mind, that includes the components indicated below. An example proposal document is available upon request. Proposed interdisciplinary program title Names and professional affiliations of Advisor and advisory committee members, including the rationale for their inclusion on the committee and identification of their areas of expertise relevant to the proposed research program Career goals and personal motivation for pursuing an IPhD A brief description of the interdisciplinary program. A short literature review along with a summary of objectives or anticipated products must be included. The description should make the case that:

1) the program comprises a distinct union of disciplinary expertise, coursework, and research methodologies, 2) the research proposed under this interdisciplinary umbrella is truly scholarly in nature (i.e., worthy of a doctoral dissertation) and 3) that the proposed scholarly work can best be accomplished via an interdisciplinary program as opposed to a traditional single discipline. A provisional Plan of Study for the IPhD degree that indicates how credit hour and course requirements will be met. Plan of study must include courses from multiple colleges and departments and must be distinct from plans of study of existing degree programs at Virginia Tech. A table including the rationale for including each course and the disciplinary area supported is helpful. Completed and current coursework (unofficial transcripts are acceptable). A description of the anticipated format and content of the preliminary examination, including topic areas to be covered from various disciplines involved and an assessment of the success of disciplinary integration A brief description of the final product(s) that will constitute the archival manifestation of the IPhD work. The products should include, but need not be restricted to, a written document that explores the scholarly history and context of the interdisciplinary work. Detailed timeline from enrollment to graduation The Graduate School does not provide funding to support students earning the IPhD. Students are encouraged to seek funding through faculty grants, departmental funds, and/or other funding opportunities such as IGEP programs, scholarships and fellowships from VT or external sources.

INDUSTRIAL AND SYSTEMS ENGINEERING

Eileen Van Aken, Head

Professors: Peter Beling; John Casali; Brian Kleiner; Michael Madigan; Maury Nussbaum; Subhash Sarin; Gaylon Taylor; Konstantinos Triantis; Kwok Tsui; Eileen Van Aken;

Associate Professors: Esra Buyuktahtakin Toy; Deborah Dickerson; Kimberly Ellis; Joseph Gabbard; Myounghoon Jeon; Sheila Klauer; Zhenyu Kong; Prahalada Rao; John Shewchuk;

Assistant Professors: Manish Bansal; Xi Chen; Navid Ghaffarzadegan; Robert Hildebrand; Niyousha Hosseinichimeh; Ran Jin; Blake Johnson; Rohit Kannan; Sajad Khodadadian; Andrea L'Afflitto; Nathan Lau; Sol Lim; Rafael Patrick; Binyang Song; Taylan Topcu; Sait Tunc; Huaiyang Zhong;

John Grado Professor: John Casali;

Ralph H. Bogle Jr. Professor: Brian Kleiner;

Hal G. Prillaman Professor: Maury Nussbaum;

Paul T. Norton Endowed Professor: Subhash Sarin;

Charles O. Gordon Professor: Gaylon Taylor;

John Lawrence Professor: Konstantinos Triantis;

Research Associate Professors: Tao Sun;

Main Campus Graduate Program Contact: hsswiger@vt.edu

Off Campus Graduate Program Contact: hsswiger@vt.edu

Graduate Site: https://www.ise.vt.edu/academics/graduate.html

Main Website: https://www.ise.vt.edu/

Graduate Admissions Information:

https://www.ise.vt.edu/academics/graduate/application.html

The Grado Department of Industrial and Systems Engineering (ISE) offers a broad-based program allowing students to pursue graduate study commensurate with their career goals. Specific strengths of the program are in the areas of human factors engineering and ergonomics, general industrial engineering, management systems engineering, manufacturing systems engineering, operations research, engineering administration, and systems engineering. The Ph.D. degree is offered in Industrial and Systems Engineering, and the master's is offered in Industrial and Systems Engineering (MS & MENG), Engineering Administration (MEA), and Systems Engineering (MS).

SPECIAL FACILITIES

Creating and maintaining state-of-the-art facilities is one of the most challenging aspects of a top 10 ISE department. Through private giving, research sponsorship, equipment donations and state support, we strive to provide the very best technology for our students and sponsors. For more information on our many labs, centers and other facilities, see the facilities page of the ISE web site: https://www.ise.vt.edu/about/facilities.html

Research Facilities

https://www.ise.vt.edu/research/labs.html

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

TOEFL

iBT: (90.0)

https://www.ise.vt.edu/academics/graduate/ms.html

Degree Concentrations:

Human Factors Engineering and Ergonomics

https://www.ise.vt.edu/academics/graduate/ms/hfee.html

Mangement Systems Engineering

https://www.ise.vt.edu/academics/graduate/ms/mse.html

Manufacturing Systems Engineering

https://www.ise.vt.edu/academics/graduate/ms/mfg.html

Operations Research

https://www.ise.vt.edu/academics/graduate/ms/or.html

General Industrial Engineering

https://www.ise.vt.edu/academics/graduate/ms/gie.html

PhD Degree

Offered In (Blacksburg)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

TOEFL

iBT: (90.0)

Information on all PhD concentrations can be found on the ISE website https://www.ise.vt.edu/academics/graduate/phd.html

MEA Degree

Offered In (Leesburg, Southwest Virginia, Virtual, Hampton Roads, Richmond, National Capital Region, Roanoke)

TOEFL

iBT: (90.0)

https://www.ise.vt.edu/academics/extended/mea.html

PhD Degree

Offered In (National Capital Region)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

TOEFL

iBT: (90.0)

https://www.ise.vt.edu/academics/extended/phd.html

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

iBT: (90.0)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

https://www.ise.vt.edu/academics/graduate/ms.html

MS Degree

Offered In (Leesburg, Southwest Virginia, Virtual, Hampton Roads, Richmond, Blacksburg, National Capital Region, Roanoke)

TOEFL

Paper: (577.0)

iBT: (90.0)

https://www.ise.vt.edu/academics/extended/syseng.html

GRADUATE COURSES (ISE)

ISE 5015:

Management of Change, Innovation & Performance in Organizational Systems

Control, management, and improvement of complex organizational systems. A mix of theories and cases for designing and improving managerial processes such as planning, performance measurement, and evaluation, as well as organizational learning and leading change. 5015: Managing performance, learning, change, and innovation in organizational systems. Pre: Graduate standing. 5016: Measurement and evaluation of performance of organizational systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5016:

Management of Change, Innovation & Performance in Organizational Systems

Control, management, and improvement of complex organizational systems. A mix of theories and cases for designing and improving managerial processes such as planning, performance measurement, and evaluation, as well as organizational learning and leading change. 5015: Managing performance, learning, change, and innovation in organizational systems. Pre: Graduate standing. 5016: Measurement and evaluation of performance of organizational systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5015

Corequisite(s):

ISE 5024:

ISE Seminar

Discussion of research projects and results of sponsored and other research in the ISE Department and elsewhere, including descriptions of specialized equipment and facilities. In addition orientation to the department, its organization and operation is provided.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5034:

Mathematical Probability and Statistics for Industrial Engineers

One-semester mathematical foundations for graduate study of engineering oriented probability and statistics. Re-introduces probability in a rigorous mathematical fashion and re-introduces mathematical statistics as an application of mathematical probability. Establishes a solid mathematical foundation for the type of probability (and statistics) modeling and analysis that is characteristic of graduate industrial engineering curricula and practice. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5044:

Production Systems Analysis

Principles, models, and methods for addressing operational problems in manufacturing systems. Application of fundamental measures such as cycle time, throughput, capacity, work-in progress, inventory, and variability for understanding, controlling and optimizing performance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): ISE 5034, ISE 5405

ISE 5104:

Operations Research

Basic techniques and methods of operations research, including the operations research approach to decision making, model formulations, and analytical methods for their solution. Introduction to implementing these models and methods. Fundamental aspects of optimization techniques (e.g., linear, integer, dynamic and nonlinear programming), network analysis, and Markov processes. Not for credit for students in the Operations Research or Manufacturing Systems Engineering tracks or by students who have taken 5405. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5114:

Case Studies in Industrial Engineering

Applications of the methodologies in Industrial Engineering and Operations Research to actual problems in Business, Industry and Government operations. The study will cover all the phases of analysis, problem description, system structure, model development and validation and solution techniques. Student involvement in the case studies will be accomplished through project assignments. Not for credit for M.S., M.E., or Ph.D. degrees in ISE.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5104, ISE 5434, STAT 5004

Corequisite(s):

ISE 5124:

Quality Management

Principles that provide the foundation for developing, enhancing, and managing the quality capabilities of all systems within a technology-centric enterprise. Quality management activities covered include defining quality based on quality management theory, formulating models for quality assessment using quality standards, strategically planning for quality, computing quality measures, designing improvement strategies, and linking to other enterprise performance metrics. Examination of these activities in the context of designing and managing production, service, and managerial processes that lead to the improvement of an enterprise's quality, products, and services. Concepts demonstrated through selected case studies and a translational research project. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5134:

Management Information Systems

Systems approach to management, domains of responsibility, structured and synergistic management tools, management system model, contextual frameworks, information portrayal, automation objectives model, evaluation, shared information processing, information modeling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5144:

Management and Measurement of Efficiency & Productivity

Principles that provide the foundation for the design and application of process-oriented efficiency and productivity performance measurement and management systems. Links between the efficiency/productivity measurement literature, systems thinking, and socio-technical systems. A focus on benchmarking (assessing) current productivity/efficiency levels, identifying peers, defining performance targets, planning (designing) future efficiency and productivity interventions, and linkages between efficiency/productivity with profitability. Modeling approaches of efficiency and productivity measurement covered include: index numbers, optimization approaches such as data envelopment analysis (DEA), statistical approaches such as statistical frontier analysis (SFA), fuzzy set approaches, and dynamic modeling approaches such as system dynamics. Concepts demonstrated by completing a research project requiring translating basic tenets of efficiency/productivity measurement literature into practice by analyzing empirical datasets. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5154:

Applied Human Factors Engineering

An examination of present human engineering design criteria, principles, and practices to achieve mission success through integration of the human into system, subsystem, equipment, and facility design in order to achieve effectiveness, simplicity, efficiency, reliability and safety of system operation, training and maintenance. Not for credit for students pursuing the M.S. or Ph.D. in the Human Factors option.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5164:

Transfer and Application of Emerging Technology

Transfer of emerging technological developments from scientific discovery and invention through product development, leading to value-added applications in private sector and government enterprises. Market and technological research, forecasting, test and evaluation, outsourcing R & D, community/government support programs, legal protection and regulation of intellectual property, economic development, economic risk and similar issues supporting the management of technological innovation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5174:

Engineering Program and Project Management

The project approach as applied in the accomplishment and management of complex technical work typically performed by engineers, scientists and other technology professionals. Practical application and ongoing enhancement of program and project management systems with emphasis on process, techniques, standards, empirical guidelines, computer software, teamwork and economic considerations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5204:

Manufacturing Systems Engineering

Conceptual models of manufacturing, process, and service organizations for various operational levels. Functional activities and interrelationships for each type of manufacturing model. Typical objectives, operating constraints, and informatics for functional activities: production planning/control, material management, facility design/material handling, manufacturing engineering, and quality control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5244:

Facilities Planning and Material Handling

Fundamental quantitative approaches to facilities planning at multiple levels of the supply chain. Emerging strategies, principles, theories, and applications in facilities planning. Decision theory, deterministic and probabilistic mathematical models and solution algorithms for the facility

layout and location problems, warehousing and storage systems, and material handling systems. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ISE 5264:

Modeling and Analysis of Semiconductor Manufacturing

Modeling and analytical concepts and techniques used for operational control of a semiconductor manufacturing facility. Topics include capacity planning, scheduling, lot sizing, lot release, re-entrant flow, and batching.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): ISE 5204, ISE 5405

ISE 5314 (AOE 5354):

Industrial Robotics

Design, programming principles, and performance evaluation methods for robotic systems employed for both classical and advanced manufacturing applications. Common design choices for industrial robots, underlying dynamical models, and their performance are analyzed. Position and attitude representation techniques, direct and inverse kinematic problems, singularity analysis through a study of the Jacobian matrix, and dynamical modeling of industrial robots are discussed. Both classical and advanced control techniques are synthesized to guarantee high performance both in nominal and off-nominal conditions. Elements of computer vision for industrial robotics are presented. Pre: Graduate standing.
Credit Hour(s): 4
Lecture Hour(s): 3
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s):
Corequisite(s):

ISE 5405:

Optimization: Linear and Nonlinear Programming

Introduction to theory of linear and nonlinear programming. A mix of theoretical concepts and numerical algorithms to solve the linear and nonlinear programming problems. 5405 (Linear Programming): Modeling for real world problems using linear programming and integer linear programming. Geometric foundations for linear programs – characterization for polyhedral sets and convex analysis. Numerical algorithms for linear programs: simplex method (its geometry and algebra), primal-dual simplex algorithm, revised simplex, two-phase and big-M methods. Farkas' Lemma and Optimality Karush-Kuhn-Tucker (KKT) conditions for linear programs. Duality theory, sensitivity analysis, state-of-the-art modeling language and solvers. 5406 (Nonlinear Programming): Convex analysis and optimization. Fritz John and KKT optimality conditions and numerical algorithms for nonlinear programs. Unconstrained and constrained nonlinear optimization. Convex optimization problems. Numerical methods: Line search methods, steepest descent method, Newton's method, conjugate directions method, projection gradient method, affine scaling method. Pre: Graduate standing for 5405; 5405 for 5406.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ISE 5406:

Optimization: Linear and Nonlinear Programming

Introduction to theory of linear and nonlinear programming. A mix of theoretical concepts and numerical algorithms to solve the linear and nonlinear programming problems. 5405 (Linear Programming): Modeling for real world problems using linear programming and integer linear programming. Geometric foundations for linear programs – characterization for polyhedral sets and convex analysis. Numerical algorithms for linear programs: simplex method (its geometry and algebra), primal-dual simplex algorithm, revised simplex, two-phase and big-M methods. Farkas' Lemma and Optimality Karush-Kuhn-Tucker (KKT) conditions for linear programs. Duality theory, sensitivity analysis, state-of-the-art modeling language and solvers. 5406 (Nonlinear Programming): Convex analysis and optimization. Fritz John and KKT optimality conditions and numerical algorithms for nonlinear programs. Unconstrained and constrained nonlinear optimization. Convex optimization problems. Numerical methods: Line search methods, steepest descent method, Newton's method, conjugate directions method, projection gradient method, affine scaling method. Pre: Graduate standing for 5405; 5405 for 5406.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ISE 5405

Corequisite(s):

ISE 5414:

Random Process

Stochastic processes of use in many areas of study, specifically industrial engineering and operations research. Emphasis on Markov processes. Applications will be given.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5034

Corequisite(s):

ISE 5424:

Simulation I

Introduction to stochastic discrete-event simulation. Theoretical foundations for stochastic simulation methodology and design, and analysis of simulation experiments. Simulation modeling and programming in general-purpose languages and using some specialized simulation software packages. Applications are drawn from various settings, such as manufacturing, financial, logistics, and service systems. Course projects on solving a real-world decision-making problem under uncertainty, each involving building a simulation model based on a case description, conducting design of simulation experiments, and performing simulation-based analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5034 OR STAT 5104

Corequisite(s):

ISE 5434:

Economic Project Evaluation

Application of economic principles and capital budgeting in the management of engineering projects, including investment in new facilities and technologies for improving production and/or service processes. Deterministic, stochastic, and multi-attribute evaluation approaches in conjunction with the objectives of wealth and utility maximization, as well as cost minimization and risk reduction. Methodologies for the economic evaluation of project alternatives, such as capital budgeting, cost estimating, life cycle costing, and activity-based costing. Defining and implementing an economic analysis framework to provide the capability to make investment decisions within enterprises. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5454:

Production Planning and Control

Introduction to mathematical analysis of various aspects of production planning and control using deterministic and stochastic models. Topics include inventory control, forecasting, aggregate production planning, lot sizing, production and project scheduling, and line balancing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5405

Corequisite(s):

ISE 5464:

Queueing Theory

Classic models of queues including M/M/1, M/GI/1, and GI/M/s. Topics in queue length processes, waiting time processes, busy period processes, and traffic processes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5414

Corequisite(s):

ISE 5474 (STAT 5474):

Statistical Theory of Quality Control

Development of statistical concepts and theory underlying procedures used in quality control applications. Sampling inspection procedures, the sequential probability ratio test, continuous sampling procedures, process control procedures, and experimental design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5104, STAT 5114

Corequisite(s):

ISE 5604:

Human Information Processing

Human capabilities and limitations in perception and cognition for system operations and work environments. Analysis of system work environments for compatibility with human perception and cognition. Assessment methods of human performance. Design of experiments for studying psychophysics and human factors engineering designs. Quantitative modeling of psychophysics and human-machine interaction. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5614 (BMES 5214):

Human Physical Capabilities

Focuses on the modeling, analysis, and evaluation of industrial workplaces with emphasis on the physical demands placed on and the capabilities of workers. Topics covered include: physiology, anthropometry, bioinstrumentation, and biomechanics. Students will learn and apply a range of contemporary analytical and assessment methods. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5624:

Human Factors Research Design

Procedures for conducting and analyzing human factors and ergonomics experiments, including fundamentals of research; benefits and limitations of design alternatives; fitting, testing, and assessing statistical models; and data presentation and interpretation. Primary focus on linear regression (simple and multiple) and analysis of variance (single and multiple factor). Pre: Graduate Standing.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5644:

Human Audition and Auditory Display Design

An examination of the human sensory and perceptual experience of sound, with emphasis on relating the capabilities and limitations of audition to the design of auditory display systems and to noise abatement in hearing conservation efforts. In addition to discussion of human sound reception and sensitivity, human psychological and physiological responses to sound will be covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5654:

Human Factors System Design

Human factors engineering input into operator-system/product design, development, testing, and evaluation. Emphasis on a systems-oriented and human-centric approach to achieving effective human-machine interfaces. Application of standards, codes and guidelines, as well as empirical methodologies and analytical techniques, to human interface applications and problems. Coverage of human sensory/perceptual capabilities and limitations, with particular emphasis on vision and hearing. Project involving analysis and redesign of an actual device or system with known human factors deficiencies. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5674:

System Safety Analysis

The analytical techniques and documentation requirements to provide proper design of equipment and systems and to protect against products liability. Safety concepts, legal concepts, qualitative and quantitative hazard evaluation, hazard classification, system life cycle safety, statistical distributions, software safety analysis, inductive and deductive analysis, Mort, Fault Tree, hands-on projects emphasizing hazard identification and control.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5694:

Macroergonomics

The optimization of work system design through consideration of relevant personnel, technological, and environmental variables and their interactions. Emphasis is on the theoretical background, research methods, analyses, design, development and applications of work systems and the relationship between macro- and micro-ergonomics.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ISE 5714 (CS 5714):

Usability Engineering

Design and evaluation of effective user interfaces, beginning with principles for designing the product. Development process for user interaction separate from interactive software development. Development process includes iterative life cycle management, systems analysis, design, usability specifications, design representation techniques, prototyping, formative user-based evaluation. Integrative and cross-disciplinary approach with main emphasis on usability methods and the user interaction development process.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ISE 5734:

Occupational Health and Safety Practicum

Industry-based field instruction and faculty mentoring for advanced learning and practice opportunities relevant to professional ergonomics and safety engineering work. Eighty hours of field practicum experience, to develop and refine knowledge and application of advanced level ergonomics and/or safety engineering practices in a real-world occupational setting. The mentoring component of this course involves regular discussions of field experiences with the instructor and others enrolled in the practicum.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (ISE 5614 (UG) OR BMES 5214 (UG)) OR ISE 5674 (UG)
Corequisite(s):

ISE 5804:

Fundamentals of Systems Engineering

Fundamental aspects of systems engineering. The role of systems engineering in engineering projects. System life cycle. Systems engineering as an engineering discipline, study and application of technical strategies to realize engineered systems. Basic tools and techniques to identify a need, formulate a problem (e.g., through requirements), develop a system architecture, acquire its building components, integrate them to form the system, verify and validate it, deploy it, and sustain it using a systems approach. Human and social aspects of systems engineering. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ISE 5814:

System Dynamics Modeling of Socio-Technical Systems

Computer-aided approach to systems thinking. Dynamic modeling to make better decisions in complex socio-technical systems. Simulation of dynamic problems arising in complex technological, social, managerial, economic, or ecological systems. Simulation-based policy analysis. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ISE 5834:

Decision Analysis for Engineers

Foundations of decision analysis contextualized for engineering work. Concepts and techniques for framing and modeling engineering problems as decisions that traverse physics by incorporating firms objectives and the personal preferences of the engineer. Formal and informal limitations of decision methods traditionally used in engineering, such as rank matrices. Alternative theories and methods that foster good decisions. Risk assessment and management as inherent to engineering decision making. Sensitivity analysis. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

ISE 5844:

Healthcare Systems Engineering and Modeling

Systems modeling and simulation of managerial decision making in complex healthcare settings. Focus on major components of healthcare delivery systems including system resources, system processes, and system outcomes; tools that systems thinking and system dynamics offer for understanding complexities in healthcare systems and for designing policy interventions, examining theoretical advancements as related to modeling healthcare systems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5854:

Mission Engineering I

Concepts and principles of Mission Engineering and System-of-Systems (SoS). Formal and informal limitations of analysis and operational planning methods traditionally used in engineering. Mission threads to determine mission operational needs and SoS requirements. Mission architecture and governance structure development. Mission safety, security, integration, interoperability, cost estimation, risk analysis, and experimentation and text. Mission framing, modeling, and simulation. Requires proficiency in fundamental principles and concepts of systems engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5834

Corequisite(s):

ISE 5864:

Problem Formulation and Decomposition

Different types of problem spaces: outcomes vs functions. Formally distinguishing problem from solution. Formal modeling of needs and requirements. Formal syntax and ontologies for textual formulation of needs and requirements. Elicitation and derivation as a byproduct of mission engineering. Decomposition as a byproduct of systems architecture. Mixed-formulation approaches. Traceability. Techniques to identify necessary vs constraining needs and requirements. Techniques to identify gaps in needs and requirements. Ordering the problem space: preferences and value functions. Requires proficiency in fundamental principles and concepts of systems engineering. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ISE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

ISE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ISE 6014:

Proposing Industrial Engineering Research

Processes involved with proposing research in industrial engineering. Methods and approaches to generate effective proposals. Alternative mechanisms involved in identifying and proposing research. Material is examined through several exercises and case studies. Course is intended for second- year doctoral students who have completed the preliminary exam but have not yet defended the proposal. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 6024:

Advanced Topics in Management Systems Engineering

A research-oriented course reviewing the engineering literature in management systems engineering of selected complex systems, structures, and techniques. Industrial, service, governmental, and health care systems will be considered. State-of-the-art topics will be examined to an extent not covered in other courses. May be repeated, with different content, for a maximum of nine credit hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 6404:

Graph Theory and Network Flows

Graph theoretic concepts and definitions, optimization problems over graphs, and basic results; minimum cost network flow problems (including assignment, transportation, max flow, and shortest-path problems) and associated algorithms with implementation strategies; PERT and CPM; and network design and synthesis problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5405

Corequisite(s):

ISE 6414:

Integer Programming

Modeling with integer variables; enumeration and cutting plane methods; partitioning and relaxation techniques; computational complexity issues; and some special combinatorial optimization problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5405

Corequisite(s):

ISE 6424:

Dynamic Programming

Introduction to the theory, applications, and computational aspects of dynamic programming and Markovian decision processes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5405, ISE 5414

Corequisite(s):

ISE 6434:

Scheduling and Sequence Theory

Theory of deterministic scheduling, including scheduling jobs on a single processor and on multiple processors (parallel, flow shop, job shop, and open shop), and complexity of computations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5405

Corequisite(s):

ISE 6444:

Inventory and Operations Management

A fundamental course on mathematical models designed to support production and inventory management, focusing on recent developments inspired by prominent managerial and engineering concerns. These developments include both innovative models and interesting new perspectives on older ones. One central theme is process improvement through reducing leadtimes and improving quality. Models reveal how process parameters affect system performance, and thus estimate the economic benefits of improving them. Another central theme is the coordination of diverse activities, and the key role of inventories as buffers between them.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5405, ISE 5414

Corequisite(s):

ISE 6464:

Queueing Networks

Applications of queueing theory results to queueing networks. Topics include reversibility, insensitivity, product forms for queue length processes, and traffic processes including traffic flow within the network.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5464, ISE 6504

Corequisite(s):

ISE 6474:

Reliability Theory

An introductory graduate-level examination of mathematical models of failure processes and complex system reliability. Included are existing probability models of component and system failure processes, statistical and experimental methods for estimating failure behavior, and optimization models for supporting design, replacement, and maintenance decisions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5414, ISE 5405, STAT 5004

Corequisite(s):

ISE 6494:

Advanced Simulation

Methodological and theoretical foundation for stochastic simulation and Monte Carlo techniques. A comprehensive discussion of Monte Carlo techniques and algorithms for simulation output analysis, simulation-based optimization, rare-event simulation, variance reduction techniques, and simulation metamodeling methodology. Exposure to contemporary research topics in stochastic modeling and simulation methodology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ISE 5034 OR STAT 5104), (ISE 5414 OR STAT 5434)

Corequisite(s):

ISE 6514:

Advanced Mathematical Programming

Convex analysis, optimality conditions, network flows, decomposition algorithms, linear programming theories, duality theories, conic programming including semidefinite programming, integer programming, stochastic optimization, robust optimization. Various topics on applications of mathematical programming, such as financial engineering, transportation, machine learning, and data analytics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5405 OR ISE 5406

Corequisite(s):

ISE 6574 (ECE 6774) (AOE 6774) (ME 6574):

Adaptive Control Systems

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 6604:

Human Factors in Visual Display Systems

Quantitative analysis of human visual system capabilities and limitations, and their relationship to the design of visual display components and systems. Emphasis is placed on the measurement and physics of light, visual science data, hardware design, and the use of linear systems theory in display design and evaluation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5604, ISE 5654

Corequisite(s):

ISE 6614:

Human Computer Systems

Survey of human-computer interaction theory, procedures, and methods in the design of computer-based systems. Emphasis on perspectives in human-computer interaction (cognitive, emotional, social), iterative interface design processes, software interface design, hardware interface design, workplace design, and human/automation interaction design. Project involving analysis, design, and evaluation of machines, services, or systems with known human-computer interaction design principles and methods. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 6624:

Advanced Topics in Human Factors

A research-oriented course reviewing the scientific literature in Human Factors Engineering of selected complex systems. Industrial, civil, transportation, military and computer-based systems will be considered. State-of-the-art topics will be examined to an extent not covered in other courses. May be repeated, with different content.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 6644:

Cognitive Work and Task Analysis

Formative, descriptive and normative approaches to work analyses. Comparison between correspondence versus coherence-driven domains. Classes of cognitive systems engineering requirements: work domain, control task, strategies, social organization, and worker competencies. Distinct contributions of different analyses to cognitive systems engineering. Application of cognitive systems engineering analyses: abstraction decomposition space, decision ladder, hierarchical task analysis, information flow map, and skills-rules-knowledge taxonomy. Derivation of design requirements from different analyses for handling unanticipated and routine events in safety critical systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5604, ISE 5654

Corequisite(s):

ISE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ISE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

INFORMATION TECHNOLOGY

Parviz Ghandforoush, Head

Professors: France Belanger; Parviz Ghandforoush; Lara Khansa; Narendran Ramakrishnan; Steven Sheetz; Leonard Smith;

Associate Professors: Wade Baker; Donald Hatfield; Barbara Hoopes; Raymond Major; David Townsend;

PricewaterhouseCoopers Senior Faculty Fellow of ACIS: Steven Sheetz;

Sonny Merryman Inc. Professor: Lara Khansa;

R. B. Pamplin Professor and Tom & Daisy Byrd Senior Faculty Fellow: France Belanger;

Thomas L. Phillips Professor of Engineering: Narendran Ramakrishnan;

Professor of Practice: David Simpson;

Collegiate Assistant Professors: Kenneth Edmison; Kendall Giles;

Associate Professor of Practice: Gregory Kulczycki;

Adjunct Faculty: Patrick Butler; Kenneth Davidian; Alexandra Hyler; Randolph Marchany; Mark Oliva; Jeffrey Ransbottom; David Raymond;

Collegiate Associate Professors: Alkan Soysal; Nektaria Tryfona;

General Contact: vtmitadmissions@vt.edu

Graduate Site: https://vtmit.vt.edu/

Virginia Tech's Master of Information Technology program is a fully online, interdisciplinary graduate degree program offered collaboratively by Virginia Tech's College of Engineering and the Pamplin College of Business. The program is asynchronous and designed for working professionals wanting to study in the rapidly expanding and evolving areas of information technology including cybersecurity, artificial intelligence, data analytics, software development and electronic networks. Students may pursue the full 33-credit master’s degree or enroll in one of ten graduate certificate programs: Big Data Business Data Analytics Cybersecurity Management Cybersecurity Policy Cybersecurity Technologies Health Information Technology Information Systems Design Information Technology Management Internet and Network Technologies Software Development

SPECIAL FACILITIES

Virginia Tech offers the Master in Information Technology degree program in an online format. Students may take courses online from any location around the world. There are no residency requirements.

Virtual Environment

While learning in a fully virtual environment, students enjoy a dynamic environment. Through a suite of collaboration tools, students interact with their cohort, faculty, and administration to solve problems, complete projects, network, and establish relationships that they will maintain throughout their career.

DEGREES OFFERED

MIT Degree

Offered In (Virtual)

TOEFL

Computer: (90.0)

IELTS: (6.5)

Thirty-three credits are required for the Master of Information Technology degree. Each student must complete four of six core courses and seven elective courses. Students are encouraged to focus elective study in areas of specialization: Analytics and Business Intelligence, Big Data, Business Information Systems, Cybersecurity, Cybersecurity Management, Cybersecurity Policy, Decision Support Systems, Health Information Technology, Innovation & Entrepreneurship in AI/ML, Networking, Software Development, and Software Engineering. The core courses include Fundamentals of Computer Systems, Information Systems Design & Database Concepts, Object-Oriented Programming with Java, Software Engineering, Strategic Leadership in Technology-Based Organizations, and Web-based Applications and E-Commerce. Graduate Certificates are offered in Big Data, Business Data Analytics, Cybersecurity Management, Cybersecurity Policy, Cybersecurity Technologies, Health Information Technology, Information Systems Design, Information Technology Management, Internet and Network Technologies, and Software Development.

INTERFACES OF GLOBAL CHANGE

Dr. William Hopkins, Director: hopkinsw@vt.edu

Ms. Bri Wills, Program Coordinator: bmwills@vt.edu

Ms. Jessica Zielske, Program Support: jcoker@vt.edu

Program Website: https://globalchange.vt.edu/graduate/interdisciplinary-phd-training.html

The Interfaces of Global Change (IGC) program is an innovative interdisciplinary graduate education program designed to address the multidimensional aspects of global change. Funded by the Virginia Tech Graduate School, this program is one of several Interdisciplinary Graduate Education Programs (IGEPs). These programs address a variety of complex societal issues requiring interdisciplinary teams of scholars. Participants (Ph.D. Fellows) typically enter the program at the beginning of their graduate studies and continue to participate throughout their time at Virginia Tech.The Interfaces of Global Change program is closely aligned with the Global Change Center, which focuses on the social, economic, and environmental causes and consequences of global change.The goals of the IGC IGEP are to provide each PhD Fellow with a broad perspective on: The social, economic, and environmental causes and consequences of global change. The roles that science and scientists play informing public understanding, engaging with other stakeholders, designing sound environmental policy, and effective communication of science to diverse audiences. The purpose and practice of collaborative, team-based, interdisciplinary research. Professional development tools leading to career success. Ph.D. Fellows in the IGC IGEP will be part of a campus-wide network and community of scholars studying diverse facets of global change. During their tenure at Virginia Tech, they will have unique access to visiting scholars, workshops, and other professional development opportunities. After graduating, they will become part of our community of diverse alumni solving global challenges around the globe.Ph.D. Fellows enrolled in the IGC IGEP will receive training in the following four areas by integrating the training they receive in their home departments with the additional resources and opportunities provided by the IGC IGEP. Global change: The IGC emphasizes the social, economic, and environmental causes and consequences of global change. Students acquire understanding of these broad topics through a variety of mechanisms including: their dissertation research and supporting degree-related course work; the 3-credit “IGC breadth elective” required outside a student’s disciplinary home; the annual IGC graduate student symposium; disciplinary and problem-based flash talks occurring in the three IGC seminar courses; exposure to experts hosted by the GCC for distinguished lectures, seminars, workshops, etc. Science in Society: The IGC emphasizes the roles of science and scientists in society and how our fellows can be more influential. The IGC seminars emphasize this topic, along with invited speakers and professional development workshops. Example sessions from the seminars include: advocacy versus honest broker; communicating science; science arbitration; joint fact finding; wicked problems and adaptive management, science policy; science advisory boards; government people and process; climate denial; decline of expertise; stakeholder analysis and transdisciplinarity. Collaborative Team Science: The IGC helps fellows effectively conduct multidisciplinary/ interdisciplinary research. In addition to sessions on this topic as part of the IGC seminars, the capstone project enables students to practice this skill with a team of graduate students and faculty mentors. Example sessions in the seminar courses: team formation and function, conflict resolution, project management, differences of disciplinary, multidisciplinary, and interdisciplinary research; case studies from literature; case studies of global change faculty. Professional Development: The IGC helps Fellows succeed as professionals. Topics covered in seminars include: career planning, CV writing, individual development plan, teaching versus research paths in academia, work-life balance, and psychological resilience. The Interfaces of Global Change program does not grant degrees. Students still receive their Ph.D. degree from their home department. The IGC provides students with a unique intellectual focus and additional training beyond the disciplinary expertise they develop in their home department. Our goal is for each student to gain depth in their specific scientific area of expertise while simultaneously gaining breadth in the multifaceted realm of global change and the science-policy interface.Our core faculty members represent a diversity of scientific and societal perspectives as well as a community of scholars spanning all stages of their academic career. We represent 23 departments and 8 colleges on campus, and one off-campus center, with strong inclusion of both the sciences and social sciences. Reaching across so many academic units is required to achieve our vision for interdisciplinary training.Colleges and DepartmentsCollege of Agriculture and Life Sciences Agricultural and Applied Economics Biochemistry Entomology School of Plant and Environmental Sciences College of Engineering Biological Systems Engineering Civil and Environmental Engineering Computer Science College of Liberal Arts and Human Sciences History Philosophy College of Natural Resources and Environment Fish & Wildlife Conservation Forest Resources and Environmental Conservation Geography Sustainable Biomaterials Virginia Water Resources Research Center College of Science Biological Sciences Geosciences School of Neuroscience Statistics College of Architecture and Urban Studies School of Public and International Affairs College of Business Business Information Technology Hospitality and Tourism Management College of Veterinary Medicine Population Health Sciences Biomedical Sciences and Pathobiology

SPECIAL FACILITIES

245-1 Steger Hall

The Interfaces of Global Change program is an interdisciplinary graduate program that draws faculty and graduate students from 8 colleges on campus. The main office is located in 245-1 Steger Hall.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

This is not a degree granting program

LANDSCAPE ARCHITECTURE

Terry Clements, Chair

Professors: Terry Clements; Mintai Kim;

Assistant Professors: Jaeyoung Ha; Shaun Rosier; Jennifer Thomas;

Graduate Program Director: mintkim@vt.edu

LAR Program Chair: tclement@vt.edu

Landscape Architecture Program: https://lar.vt.edu/

Ph.D. in Architecture and Design Research - Landscape Architecture track: https://archdesign.caus.vt.edu/degrees/ph-d-in-architecture-and-design-research-lar/

Graduate Site: https://lar.vt.edu

The Landscape Architecture Program in the School of Architecture + Design has an established international reputation as one of North America's leading and highly-ranked programs. The program offers three tracks to a Master of Landscape Architecture (MLA)degree: a 3-year first-professional track, an advanced placement track, and a one year plus thesis track. PhD studies focused in landscape architecture are offered through the Architecture Design Research PhD in the School of Architecture + Design. Non-degree students from other universities are invited to study with us for one or two semesters. Degree applicants with undergraduate qualifications in any discipline are considered for the three-year Master of Landscape Architecture track. The first-professional degree's studio-based curriculum integrates design and planning, landscape sciences and technologies, ecology, and human/environment interaction. Applicants with a previous degree in landscape architecture, architecture or an allied area may be admitted with advanced standing to the two-year MLA track, an option that encourages students to develop an individualized program of study building upon the program's areas of expertise in community engagement, place-making, ecological design and resiliency, and design learning. Our MLA students and graduates routinely find work in design and planning firms, government and municipal agencies, and community and non-profit organizations across the United States and abroad. The three tracks to a Masters in Landscape Architecture are rigorous and intensive studies integrating students' creativity, new and developing knowledge, and problem-solving skills as they address contemporary design and planning challenges in the built environment. The Landscape Architecture Program guides students as they address some of the most important challenges of our time: climate change; healthy living and empathetic design; urbanization; just and livable cities; re-imagining water, food, energy and transportation systems; green infrastructure; remediation of spoiled and disturbed sites; and preservation and conservation of critical natural and cultural resources.

SPECIAL FACILITIES

Graduate students have permanent work stations in the open Landscape Architecture Studio. The studio is shared with other master of landscape architecture students as well as upper year undergraduate students. As part of the School of Architecture + Design, students have access to wood, ceramic, metal and print-making shops, as well as other maker-spaces.

Community Design Assistance Center

The Community Design Assistance Center assists communities, neighborhood groups, and non-profit organizations in improving the natural and built environments through design, planning, policy and research.

Landscape Architecture Studio and Program Spaces

The landscape architecture design studios feature an open plan allowing students in different courses to be part of a larger cohort of learners. The studios are located in Burchard Hall, an interdisciplinary studio space shared with Industrial Design and Architecture students. Faculty offices and seminar spaces are located in Burruss Hall, along with PhD student offices. The program has full access to all of the School of Architecture + Design facilities including wood and metal shops and print-making studios, ceramic studios, printing and plotting rooms, and photographic labs.

DEGREES OFFERED

MLA Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

The Landscape Architecture Program offers three tracks for pursuing a Master of Landscape Architecture degree (MLA), depending on the student's academic and professional experience. All students completing a MLA program at Virginia Tech will have met the Landscape Architecture Accreditation Board's (LAAB) requirements of a professional degree program. The tracks include: the three-year first-professional Master of Landscape Architecture track, the advanced placement Master of Landscape Architecture track, for those with an undergraduate degree in landscape architecture or a closely allied field, and the one-year plus thesis Master of Landscape Architecture track for those with significant professional experience. A PhD track in Landscape Architecture is offered through the School of Architecture + Design's PhD in Architecture and Design Research (ADR). The three-year first-professional Master of Landscape Architecture track is designed for individuals who have completed a bachelor's degree in a field other than landscape architecture. The program offers a design studio-based curriculum integrating three focal areas central to practice of landscape architecture into the future: people and place, community engagement, and design for resilience, Emphasis is given to developing mastery of landscape architectural design through a series of design studios and a final design thesis that investigate challenges to the built environment across a range of scales from sites to regions. Individuals are admitted on a competitive basis. Applicants, who have completed a baccalaureate degree or its equivalent, are eligible for admission. Applications are reviewed by a faculty committee and evaluated on the basis of previous academic performance, relevant experience, statement of interest, and evidence of potential to successfully pursue graduate-level work in landscape architecture. Our students have varied educational backgrounds and experience. College-level courses in the natural sciences, ecology, urban and regional planning, and the visual arts (e.g., drawing, sculpture, printmaking, and/or basic design) are recommended although not required. Applicants with previous education in design, an undergraduate degree in architecture or another closely related field, or who have substantial equivalent coursework in landscape architecture, environmental design or landscape design may be eligible for admission with advanced standing, subject to the review of the admissions committee. A transcript, coursework and portfolio review will be conducted for applicants seeking advanced standing. Interested persons are encouraged to contact the program. Admitted degree candidates will be recommended for the Master of Landscape Architecture professional degree upon satisfactory completion of 75 credit hours (typically 25 credits hours of Foundation Studies plus 50 credit hours of MLA Studies) including a design thesis. Foundation Studies prepare students to perform at the graduate level and include introductory course work in history, theory, design, technique, and natural systems. Some coursework may be waived for previous experience or content covered in undergraduate studies. MLA studies include a sequence of required studios, core coursework, and directed electives. Directed electives support the development of a student's desired area of mastery, and may be taken from areas of study offered across the university. Graduate Studies culminate with a design thesis directed by a major professor. See: 3-year First-professional MLA track. The advanced placement MLA track is tailored for students who already hold an accredited first professional-degree in landscape architecture, architecture or another closely related field. Students may receive up to a year of advanced standing (essentially the 25 credits of Foundation Studies). This MLA degree track is dedicated to the advancement of knowledge and to advancing an understanding of landscape architecture within four areas: community engaged design, design for resiliency, people and place, and design learning and education. Applicants are asked to specify their area of research interest upon application. Each student in the advanced MLA program works in consultation with a major professor to craft an individualized graduate plan of study within a specific area of focused research. The plan of study includes both general landscape architecture courses and coursework pertaining to an area of research focus. The graduate plan of study typically includes at least 50 credit hours. Nine of these hours are devoted to a capstone thesis that addresses a specific issue or question within the student's selected area of focused research. Students from a related field must also complete additional coursework necessary to fulfill any remaining requirements for a professional MLA degree. A transcript, coursework and portfolio review will be conducted to identify necessary coursework. See: Advanced Placement track Masters of Landscape Architecture The 1 Year Plus Thesis MLA is an accelerated degree designed for students who have both a professional degree in landscape architecture or a closely related field and considerable practical experience. The program is designed to allow seasoned practitioners an opportunity to earn an advanced degree by completing focused studies and a thesis in an individually tailored program. See: 1year + thesis Masters of Landscape Architecture Track. Dual Degree Programs: MLA students may pursue a simultaneous master degree in Urban and Regional Planning (MLA/MURP). The dual degree programs coordinate course requirements in both fields, assuring the integrity of each while also saving time and cost to the student. Dual degree students must be admitted to both programs following the admissions procedures in each. Students may apply for admission to both programs before enrolling in either, or they may apply after first being admitted to and enrolling in one program. In the latter case, application to the second program should be made before half the coursework in the first has been completed. The MLA/MURP Dual Degree Program recognizes the fundamental linkage between planning and design of the natural environment as impacted by humans. This program shares electives and/or the substitution of significantly relevant courses from each field. Individualized plans of study for students seeking simultaneous degrees are based upon student backgrounds and needs. A capstone product is required of each program. The capstone product may bridge the fields of each degree. Off Campus Studies: MLA students may elect to participate in the Landscape Architecture Program's Summer Education Abroad Program or in university exchange programs offering landscape architecture coursework. Off-campus coursework will be reflected in the student's individual Program of Study and must receive prior approval from their major professor.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Ph.D. in Architecture and Design Research offered at Blacksburg and National Capital Region (NCR) Campus: Students may pursue Ph.D. level studies in landscape architecture through the School of Architecture + Design's "Design Research" track of the Ph.D. program in Architecture and Design Research. Ph.D. candidates pursue an individual course of study and independent research related to an aspect of landscape architecture. The program supports candidates interested in entering academic and professional practices around the world.

GRADUATE COURSES (LAR)

LAR 5005:

Graduate Landscape Architecture Design Laboratory

Graduate landscape architecture laboratory addressing complex issues of landscape design and planning. The scope of planning and design includes the relationship of specific sites to their larger urban and/or regional contexts. Pre: undergraduate degree in landscape architecture or related field, or permission of instructor.

Credit Hour(s): 0 OR 5

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): LAR 4705, LAR 4706

Corequisite(s):

LAR 5006:

Graduate Landscape Architecture Design Laboratory

Graduate landscape architecture laboratory addressing complex issues of landscape design and planning. The scope of planning and design includes the relationship of specific sites to their larger urban and/or regional contexts. Pre: undergraduate degree in landscape architecture or related field, or permission of instructor.

Credit Hour(s): 5

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): LAR 4705, LAR 4706

Corequisite(s):

LAR 5014G:

Advanced Design & Construction Documentation

Landscape architectural project-based design and construction documentation. Site design integrating experiential learning, programming, schematic design, design development, construction documentation, construction cost estimation, and technical specifications. Construction principles and practices in preparation of site design and set of construction documents. Community-based principles and practices for site design development. Pre: Graduate Standing. Lecture (1H,1C), Lab (6L, 2C) Design Lab/Studio (5L, 3C). (1H, 11L, 6C)

Credit Hour(s): 6

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5034G:

Advanced Evolution of the American Landscape

An examination of physical change in the rural and urban landscape of America as reflected by changes in needs during the countrys history. Some of the factors influencing the character, form and use of American space that will be studied are economic growth, changing philosophies on conservation and exploitation of natural resources and their resulting legislation, technological advancement and social reform. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5044:

Land Analysis and Site Planning

Introduction to the concepts and methods of ecological resource survey and analysis at regional and site scales. Approaches to environmental problem solving with an emphasis on data collection, evaluation, and synthesis using applicable technologies such as geographic information systems. Interpretation of landscape resource data for the purpose of physical planning and design. I

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5084:

Graduate Landscape Architecture Site Planning and Design

Graduate landscape architecture laboratory addressing complex issues of landscape design and planning. Solving design and planning problems across multiple scales. Articulating design and planning position in relation to position research. Engaging in collaborative, community-based design practice. Formulating consensus-based plans and designs using geodesign framework. Evaluating impacts of plans and design. Communicating proposals graphically and orally. Variable credit course. Design Lab (1H, 6-11L, 3-6C)

Credit Hour(s): 3 TO 6

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): LAR 5124

Corequisite(s):

LAR 5124:

Graduate Landscape Architecture ResilientSite Design

Landscape architecture laboratory addressing complex issues of landscape design related to people and place. Case studies, theory and design emphasizing the relationships of sites to their communities, design for resilience and for diversity, equity and social justice. Communication of design intentions in clear and effective ways. Pre: Graduate standing. Course Contact to Credit Hour Structure: Lecture (1H,1C), Lab (6L, 2C) Design Lab/Studio (5L, 3C). (1H, 11L, 6C)

Credit Hour(s): 6

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5164:

TECT LAR I: Topo & Grading

Introduction to landscape architecture technology, focusing on the fundamentals of cartography, topography, grading, and landform manipulation. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5254:

Landscape Arch Theories

Critical examination of theories relevant to landscape architectural design and the inter-relationship among theory, practice, and research with special emphasis on contemporary theories. Evolution of theory with respect to built works. Overview of concurrent design theories and philosophies in the related arts. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5264:

TECT LAR II: Site & Process

Links landscape architectural site design with environmental and construction processes. Conceptual site designs are developed through the production of documents for layout and grading of sites, stormwater management, and design and management of vegetative processes. Technical practices are framed within larger discourses of site conceptualization and representation.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): LAR 5164

Corequisite(s):

LAR 5304G:

ADV Topics in Landscape Arch

Complex issues facing the professional practice of landscape architecture today. Special emphasis on methods of analysis and interpretation including application of creative techniques, analogous thinking, computer-aided procedures and information handling in landscape architecture design and practice. Repeatable for a maximum of 9 credits. Pre-Requisite: Graduate Standing Required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5314:

Research Topics in LAR

Range and types of contemporary research within landscape architecture. Emphasis on literature, theories, methods, and case studies used in selected focused research areas. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5334:

Landscape Architecture History

Historical development of landscape architecture with emphasis on western culture from Ancient Greece through the 20th Century. Emphasis on design theories, relationships between society and nature, conception of landscape by different social groups, and relationships between site design and urban design. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5344:

Scholarship of Place

Theory and scholarly methods related to sense of place in landscape. Overview of theoretical literature and research on sense of place. Concepts and ideas of place-making in built works. Balancing human needs and environmental concerns while providing characteristics and qualities that impact sense of place. Development practices that lead to placelessness and jeopardize the integrity of our cultural environment. Scholarly methods in place research. Prerequisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5364:

TECT LAR III: Material Constr

Links landscape architectural design, engineering, materials, and construction processes. Construction materials and assembly techniques. Preparation of landscape architectural drawings and specification. Methods of documentation are also covered, including conventional and digital communication technologies.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): LAR 5264

Corequisite(s):

LAR 5704:

Advanced Landscape Design and Planning Lab

Studio addressing advanced problems in landscape design and planning.

Credit Hour(s): 5

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): LAR 5006

Corequisite(s):

LAR 5724:

Scholarship in Landscape Architecture

An overview of scholarship in landscape architecture with emphasis on research approaches and methods pertaining to the advancement of knowledge in the profession. Application of ideas through the completion of a preliminary research project. Pre: Familiarity with landscape architecture or a closely allied environmental planning/design discipline. Non-majors by consent of instructor.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5754:

Thesis Studio

Thesis studio is an alternative to the conventional academic thesis for students pursuing a masters degree in landscape architecture. Thesis studio involves literature review, composition of a position paper grounded in design or planning theory and completion of studio projects(s) that test or demonstrate the theoretical position.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 0 TO 19

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5774:

Advanced Graduate Design Lab

Advanced graduate landscape architecture studio addressing complex issues of landscape design and planning related to student focused research areas. Literature review grounded in design or planning theory. Completion of studio project(s) that test or demonstrate the design resolution of problems in the students research area.

Credit Hour(s): 6

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): LAR 5314

Corequisite(s):

LAR 5964:

Landscape Architecture Field Studies

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI1

Instruction Type(s): Independent Study, VI1

Prerequisite(s):

Corequisite(s):

LAR 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

LAR 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

LAR 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MACROMOLECULAR SCIENCE AND ENGINEERING

Michael Bortner, Associate Head

Emeriti Faculty: Donald Baird; John Dillard; Harry Gibson; Sam Turner;

Professors: Rana Ashkar; Romesh Batra; Jonathan Boreyko; Michael Bortner; Scott Case; Jiangtao Cheng; Rebecca Cockrum; Richey Davis; Raffaella De Vita; Sanket Deshmukh; David Dillard; William Ducker; Kevin Edgar; Alan Esker; Charles Frazier; Barry Goodell; James Heflin; Matthew Hull; Scott Huxtable; Blake Johnson; Young Kim; Erdogan Kiran; John Lesko; Zheng Li; Feng Lin; Peizhen Lu; Roop Mahajan; Joseph Marcy; Steven McKnight; Robert Moore; Ranga Pitchumani; Rui Qiao; Padmavathy Rajagopalan; Jennifer Russell; Maryam Shakiba; Danesh Tafti; Carolina Tallon Galdeano; Zhenhua Tian; Rong Tong; Layne Watson; Joseph Wheeler; Christopher Williams; Hang Yu; Michael von Spakovsky;

Associate Professors: Marwan Al-Haik; Justin Barone; Bahareh Behkam; Paul Deck; Michael Ellis; Aaron Goldstein; Louis Madsen; Stephen Martin; John Matson; Amanda Morris; Amrinder Nain; Maren Roman; Gary Seidel; Diego Troya; Abby Whittington;

Assistant Professors: Irving Allen; Michael Bartlett; Shengfeng Cheng; Charles Figg; Guoliang Liu; Frederick Michel; Vinh Nguyen; Michael Schulz; Chenggang Tao; Scott Verbridge; Valerie Welborn; Joshua Worch;

Alexander Giacco Professor of Chemical Engineering: Donald Baird;

Adhesive and Sealant Science Professor: David Dillard;

Thomas M. Brooks Professor of Wood Science and Forest Products: Charles Frazier;

Clifton C. Garvin Professor of Biomedical Engineering and Mechanics: Romesh Batra;

Lewis E. Hester Chair Professor and Director of the Institute for Critical Technology and Applied Science: Roop Mahajan;

General Contact: mii@vt.edu

Graduate Site: http://mii.vt.edu

The Macromolecular Science and Engineering (MACR) graduate programs are interdepartmental, intercollegiate M.S. and Ph.D. degrees focused on polymer science and engineering. The programs are interdisciplinary in nature with faculty members from the Colleges of Science, Engineering, and Natural Resources. Students work under the direction of faculty in the departments of Chemistry, Physics, Sustainable Biomaterials, Chemical Engineering, Materials Science Engineering, Mechanical Engineering, Engineering Science and Mechanics, and Civil Engineering. Students working under the direction of these faculty may pursue the departmental curricula or the Macromolecular Science and Engineering curriculum to earn degrees in the respective programs. The MACR curriculum is designed to offer the flexibility needed to tailor interdisciplinary programs of study to emerging areas related to polymeric materials. Students may choose from four fundamental modules (Synthesis, Structure, Processing, or Mechanics of Polymers) or from a series of emerging technological domains (Polymers in Materials Medicine, Adhesion and Interfaces, Opto- and Micro-electronics, or Composites) to build technical depth. Breadth is gained through polymer courses outside the concentration area, as well as through elective coursework and research. In addition to the technical courses, the program emphasizes the development of technical oral and written communication skills, team building and leadership skills, and the option to build awareness of business practices in the polymer industries through a targeted course in this area.

SPECIAL FACILITIES

Facilities include laboratories in the ICTAS II building, Hahn Hall, Kelly Hall, and Goodwin Hall.

Material Characterization Laboratory (MCL)

The Materials Characterization Laboratory (MCL) is a state-of-the-art materials characterization laboratory associated with the Macromolecules Innovation Institute (MII) and the Institute for Critical Technology and Applied Sciences (ICTAS) Our first year students take a two semester course series around the fundamental synthesis and characterization techniques. These courses introduce students to the interdisciplinary nature of polymers and macromolecules by creating hands-on learning with the instrumentation commonly used across chemistry, physics, and engineering. The need for this diverse range of equipment is what makes the MCL such a valuable asset to our program. You can find characterization equipment that takes the student from synthesis to purification to forming and shaping to end use testing all in one spot.Facility users can collect detailed information on mechanical, thermal, and other properties of the novel materials they create, expanding the scope of their research and the potential applications for their products.Hands-on training allows students to be directly involved in sample prep, testing, and analysis, enhancing fundamental understanding and facilitating seamless collaboration.Materials Characterization Laboratory420 Kelly Hall, 325 Stanger St, Blacksburg, VA 24061

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Computer: (213.0)

iBT: (80.0)

Paper: (550.0)

GRE

General Test: Verbal, Quantitative, Analytical

Master's (M.S.) * MACR 5015/5016: Macromolecular Fundamentals with Laboratory I/II (3 cr) (sample 5015 syllabus, sample 5016 syllabus)* CHEM/CHE 5014 : Technical Oral Communications and Presentation Methods (1 cr.) (sample syllabus) or GRAD 5144: Communicating Science (2 cr.)* MACR 5024: Writing Skills for Macromolecular Science and Engineering (1 cr.) (sample syllabus)* Technical Concentration Area (6 cr. from one program module)* MACR Elective Courses (4 cr. from any remaining program modules)* MACR 5994: Research and Dissertation (minimum of 10 cr.)Total Program Hours: 32Advancement to Candidacy Requirements (M.S.)* By the end of the 2nd academic semester in residence, the student will submit an approved Plan of Study and 1st evaluation after meeting with their major professor.* By the end of the 4th academic semester in residence, the student is expected to meet with their committee and submit a 2nd evaluation.* At least once per year thereafter, the student is expected to submit an annual evaluation until the student is ready to defend his/her thesis.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

Doctor of Philosophy (Ph.D.) * MACR 5015/5016: Macromolecular Fundamentals with Laboratory I/II (3 cr) (sample 5015 syllabus, sample 5016 syllabus)* CHEM/CHE 5014 : Technical Oral Communciations and Presentation Methods (1 cr.) (sample syllabus) or GRAD 5144: Communicating Science (2 cr.)* MACR 5024: Writing Skills for Macromolecular Science and Engineering (1 cr.) (sample syllabus)* Technical Concentration Area (9 cr. from one program module)* MACR Elective Courses (6 cr. from any remaining program modules)* General Electives (9 cr.)* MACR 7994: Research and Dissertation (minimum of 58 cr.)Total Program Hours: 90Advancement to Candidacy Requirements (Ph.D.)* By the end of the 2nd semester in residence, students will submit 1st evaluation after meeting with their major professor.* By the end of the 3rd academic semester in residence, students will submit approved Plan of Study.* By the end of the 4th academic semester in residence, students will write a literature review for their dissertation project, then defend that review orally before their committee.* By the end of the 5th academic semester in residence, students are required to pass a combined written and oral examination focusing on questions pre-submitted by the dissertation committee.* At least once per year thereafter, the student will orally review his or her research before the dissertation committee (this requirement is due to the highly interdisciplinary nature of the research).

GRADUATE COURSES (MACR)

MACR 5004:

Macromolecular Graduate Seminar

Current topics and literature in macromolecular science and engineering. Principles and best practices for developing research plans and presenting results. Effective scientific communication. Scholarly ethics and research integrity. May be repeated four times with different content for a maximum of 4 credits. Pre: Graduate Standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MACR 5015:

Macromolecular Fundamentals Laboratory I and II

The course will cover fundamentals and experimental techniques for the synthesis and characterization of polymeric materials. MACR 5015 includes statistical experimental design, step-growth and chain-growth polymerization, molecular modeling, thermal properties of polymers, molecular weight analysis, morphology, and melt and solution rheology. MACR 5016 includes static and dynamic mechanical analysis, rubber elasticity, spectroscopy, surface analysis, fracture behavior, and basic polymer processing. Must meet pre-requisites or equivalent.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): CHEM 4534 OR CHEM 4634 OR CHE 4104

Corequisite(s):

MACR 5016:

Macromolecular Fundamentals Laboratory I and II

The course will cover fundamentals and experimental techniques for the synthesis and characterization of polymeric materials. MACR 5015 includes statistical experimental design, step-growth and chain-growth polymerization, molecular modeling, thermal properties of polymers, molecular weight analysis, morphology, and melt and solution rheology. MACR 5016 includes static and dynamic mechanical analysis, rubber elasticity, spectroscopy, surface analysis, fracture behavior, and basic polymer processing. Must meet pre-requisites or equivalent.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 4534 OR CHEM 4634 OR CHE 4104

Corequisite(s):

MACR 5024:

Writing Skills in Macromolecular Science and Engineering

This course focuses on methods and critiques for preparing technical abstracts, conference proceedings, technical industrial reports, refereed journal manuscripts and resumes.

Credit Hour(s): 1

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MACR 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

MACR 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MACR 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MACR 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MATERIAL CULTURE & PUBLIC HUMANITIES

Matthew Gabriele, Chair

Professors: Brian Britt; Matthew Gabriele; Sylvester Johnson;

Associate Professors: Ananda Abeysekara; Aaron Ansell; William Green; Ann-Marie Knoblauch; Michelle Moseley Christian; Emily Satterwhite; Peter Schmitthenner; Rachel Scott; Daniel Thorp;

Assistant Professors: Amaryah Armstrong; Danille Christensen; Zhange Ni; Shaily Patel; Dominique Polanco; Anne Ronan; LaDale Winling;

Professor of Practice: Deborah Sim;

Graduate Contact: ansell78@vt.edu

Graduate Contact: mymc@vt.edu

Graduate Site: https://www.mcph.liberalarts.vt.edu/

This 30-credit cross-disciplinary degree has two interrelated emphases, material culture and public humanities, and prepares students for a wide range of careers in museums, historical societies, archives, and community-building organizations. We take material culture to mean those tangible things--objects, landscapes, bodies-- that humans have shaped to their use; our studies examine these things from critical, theoretical, and historical perspectives, viewing them as expressions of cultural logics and political struggles. We take the humanities-- including the disciplines of anthropology, art history, history, literature, and music-- to refer to the study of how people make meaning out of the world. Public humanities, for us, entails the project of partnering humanities scholars with those actors who produce knowledge and remake the world outside the university The curriculum entails a minimum of 30-credits of graduate courses. We recommend that students enter the program in the fall semester. The deadline for applications for fall semester is February 15 to receive consideration for a funding (tuition and stipend) as a Graduate Assistant (GA) or Graduate Teaching Assistant (GTA). For more information about the MCPH MA Program, please visit our website: https://www.mcph.liberalarts.vt.edu , and feel free to contact the co-directors: Drs. Aaron Ansell (aansell@vt.edu) and Michelle Moseley (mymc@vt.edu).

SPECIAL FACILITIES

Students in the MA in Material Culture and Public Humanities can draw upon a variety of facilities, listed below, that will enrich their education.

Armory Gallery

Armory Gallery

Art + Architecture Library

Art + Architecture Library

Center for the Arts

Center for the Arts

Department of History

Department of History

Department of Religion and Culture

Department of Religion and Culture

School of Visual Arts

School of Visual Arts

Special Collections, University Libraries

Special Collections, University Libraries

DEGREES OFFERED

MA Degree

TOEFL

Paper: (550.0)

iBT: (80.0)

Undergraduate B.S. or B.A. degree in a humanities or design discipline, with preference given to students with degrees in Art History, Anthropology, American Studies, History, Political Science, English, Communication, History of Design, Classics, Architecture, Landscape Architecture, Religion and Culture, Interior Design, or Industrial Design. Minimum of a 3.5 in-major undergraduate GPA, 3.0 overall undergraduate GPA. Official transcripts, 3 letters of recommendation, and all other documents required by the Graduate School. Applicants with work or internship experience in a related field will be given special consideration.

MATERIALS SCIENCE AND ENGINEERING

Suneel Kumar Kodambaka, Head

Emeriti Faculty: Norman Dowling; Robert Hendricks;

Professors: Peizhen Lu; Mitsuhiro Murayama; Gary Pickrell; William Reynolds; Dwight Viehland;

Associate Professors: Alexander Aning; Levon Asryan; Sean Corcoran;

Assistant Professors: Carolina Tallon Galdeano;

Associate Professor of Practice: Alan Druschitz; Sean McGinnis;

Research Associate Professors: Carlos Suchicital;

Graduate Contact: grandska@vt.edu

MSE Website: https://mse.vt.edu/

Graduate Program: https://mse.vt.edu/Programs/graduate-program.html

The Department of Materials Science and Engineering awards the M.S. (thesis required), the M.Eng. (non-thesis), and the Ph.D. in materials science and engineering. Candidates for these degrees must hold, or be pursuing, a degree in any branch of engineering, physics, chemistry, geological science, or mathematics. Specialization is available in: 1) structure and properties of crystalline and non-crystalline materials, 2) materials synthesis, processing, and fabrication, 3) theoretical understanding and computer modeling of materials structures, properties and processes, 4) phase transformations, 5) thermodynamics and phase equilibria, 6) diffusion and kinetics of solid state reactions, and 7) mechanical, thermal, electrical, optical, and magnetic property characterization of all material types, and 8) microelectronic and optoelectronic materials.

SPECIAL FACILITIES

Specialized laboratories permit research in the following areas: thermodynamics and phase equilibria; materials corrosion and stability;

x-ray diffraction and crystal structure determination; phase transformations, precipitation hardening and diffusion in materials systems; electron (STEM, SEM, ESEM) and optical microscopy; mathematical modeling and computer simulation of structure, defects and processes; surface characterization of materials by ESCA; materials synthesis, processing and fabrication; characterization of residual stresses in materials, fabrication of thin film electronic and optical materials, mechanical alloying of metals; composite material fabrication and characterization; and electrical, optical, thermal, and mechanical property characterization of ceramics, metals, polymers and glasses including composites, thin films, dielectrics and semiconductors. A class 10,000 cleanroom is available for the preparation of microelectronic materials. Additional instructional and research facilities available to MSE personnel include the Kroehling Advanced Materials Foundry located at the Research Compound on Plantation Road and the ICTAS (www.ictas.vt.edu) Nanoscale Fabrication and Characterization Laboratory (www.ncfl.ictas.vt.edu) located at the Virginia Tech Corporate Research Center. The foundry is a state-of-the-art teaching facility with broad capabilities to handle both ferrous and non-ferrous alloys. The NCFL has over $12 million in state-of-the art tools including suites devoted to electron and force microscopy, spectroscopy, and other advanced processing and analysis techniques. The Kroehling Foundry is supervised by the VT-FIRE (Foundry Institute for Research and Education) Director, Prof. Alan Druschitz while the NCFL is managed by Prof. William Reynolds. Major research facilities include optical and transmission electron microscopy; an environmental scanning electron microscope; x-ray diffraction equipment including facilities for the measurement of residual stresses in materials; a secondary ion mass spectrometer, a photoelectron emission spectrometer, surface analysis instruments; mechanical testing frames; instruments for measuring the thermal response of materials including thermal expansion, thermal diffusivity, and differential thermal analysis; sputtering, thin film and vacuum deposition equipment; heat treatment and sintering furnaces; a metal melt spinner; mechanical alloying ball mills; dry and hot isostatic presses; electrical and dielectric characterization instruments; polymer processing and characterization equipment; and computer modeling and simulation facilities including access to multimedia and computer visualization facilities.

DEGREES OFFERED

MS Degree

TOEFL

iBT: (90.0)

GRE

General: Verbal (150.0), Quantitative (155.0), Analytical (4.0)

The M.S. degree requires a thesis. Students with an interest in applied research and development should consider this degree option. Like the M.Eng. degree, the M.S requires the completion of 30 credit hours of work. Between 6 and 10 of these credit hours are on thesis research (MSE 5994). Most students spend two academic years completing the M.S. program of study. Students are encouraged to read our Graduate Student Manual, which can be found on our website, for more detailed information about our degree requirements.

MEng Degree

TOEFL

iBT: (90.0)

GRE

General: Verbal (150.0), Quantitative (155.0), Analytical (4.0)

The M.Eng. is a non-thesis degree obtained through course work and a project that focuses on an industrial problem or critical literature review. Students with a baccalaureate degree who desire a professional-oriented master's degree and advanced undergraduate students who wish to supplement their background with additional course work are encouraged to consider the M.Eng. degree. A total of 30 credit hours are required for this degree; between 3 and 6 of these hours are project work (MSE 5904), the remainder are course credits. Students typically complete this degree in 12 to 18 months. Students are encouraged to read our Graduate Student Manual, which can be found on our website, for more detailed information about our degree requirements.

PhD Degree

TOEFL

iBT: (90.0)

GRE

General: Verbal (150.0), Quantitative (155.0), Analytical (4.0)

The Ph.D. degree is intended for exceptional students who have a strong interest in scholarship and a desire to do independent research. This degree program is designed to be flexible to meet the broad interests of students and faculty. General requirements for the degree are those of the College of Engineering. A master's degree is neither a prerequisite nor a requirement. However, many Ph.D. students complete the requirements for a master's degree while working toward the Ph.D. degree. The Ph.D. requires the completion of 90 credit hours of work. Students are encouraged to read our Graduate Student Manual, which can be found on our website, for more detailed information about our degree requirements.

GRADUATE COURSES (MSE)

MSE 5004:

Materials Science and Engineering Graduate Fundamentals

Overview of MSE program requirements; Honor code and ethics; student responsibilities; campus services; student organizations; data and time management; thesis and dissertation styles; student-mentor relationships; career building; research techniques; and communication strategies for faculty, staff, and peers. Pass/Fail only. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MSE 5014:

Presentation Skills

Methods and style to make effective technical and nontechnical

presentations including blackboard presentations, overhead presentations, slide presentations, and research posters. Video presentations with critiques.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5015:

Materials Science and Engineering Seminar

Materials Science and Engineering students are required to participate in Materials Science and Engineering Seminar during every semester of their residency. Masters of Science or Engineering students must present one seminar during the course of their studies; PhD students must present two seminars during their tenure. Provides training in the organization, preparation, and presentation of technical information. Pre: Graduate standing in MSE.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5016:

Materials Science and Engineering Seminar

Materials Science and Engineering students are required to participate in Materials Science and Engineering Seminar during every semester of their residency. Masters of Science or Engineering students must present one seminar during the course of their studies; PhD students must present two seminars during their tenure. Provides training in the organization, preparation, and presentation of technical information.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5024:

Mathematical Methods in Materials Research

Analytical and numerical techniques applied to problems in materials science. Translating physical information into a mathematical model, obtaining a solution by selecting and applying suitable mathematical methods, applying modern computing tools, and interpreting the meaning and implication of the mathematical solution in terms of the appropriate theories of materials science. An undergraduate science or engineering degree and mathematics through differential equations required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5034:

Structure and Properties of Materials

An introduction to descriptions of the structure of matter and materials properties. Bravais lattices, Miller indices, reciprocal space, stereographic projections, symmetry and crystal defects. Matrix methods for calculating crystal directions, lengths and angles. Tensor descriptions of properties. Diffraction and scattering from crystals. Undergraduate physical sciences or engineering degree is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5044:

Powder Processing

Processing methods associated with making consolidated components from powders. Preparation, blending, and compaction of metallic, ceramic, and polymeric powders. Solid-state and liquid-phase sintering. Laser and microwave sintering.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5054:

Advanced Materials Thermodynamics

Material systems with particular emphasis on alloys. Thermodynamic relationships. Experimental and computational methods for the determination of the thermodynamic properties of alloys. Applications in alloying, heterogeneous reactions, and the thermodynamics of surfaces.
Credit Hour(s): 3
Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MSE 4034

Corequisite(s):

MSE 5064:

Diffusion and Kinetics

Theories of diffusion mechanisms in solids. Solutions of governing differential diffusion equations. Classical nucleation theory, spinodal decomposition, diffusion-controlled growth kinetics, overall transformation kinetics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MSE 5024, MSE 5054

Corequisite(s):

MSE 5114:

Introduction to Materials Characterization

Introduction to techniques used to characterize material structure and chemistry. Physical principles behind surface and microanalysis techniques and the information various techniques provide. X-ray, electron, ion, vibrational, and absorption spectroscopy and optical, electron, and acoustic microscopy. Undergraduate degree in physical sciences or engineering is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MSE 5124:

Materials Optimization Through Designed Experiments

Methods of analysis of variation in materials systems, in manufacturing or R&D, through the use of statistical methods including experimental design techniques (DOE) with instructional examples related to Materials Science and Engineering. Undergraduate physical sciences or engineering degree is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MSE 5134:

Transmission Electron Microscopy

Transmission electron microscopy for research applications in the physical sciences. Theories of electron diffraction, imaging and spectroscopy on transmission and scanning transmission electron microscopes (TEM, STEM). Interpretation of electron diffraction patterns, images and spectra.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): MSE 5334

Corequisite(s):

MSE 5144 (ESM 5144):

Deformation and Fracture of Materials

Deformation and fracture of engineering materials is considered in the context of solid mechanics and engineering methods for predicting strength and life. Topics include plasticity, failure criteria, fracture mechanics, crack growth, strain-based fatigue, and creep. Microstructure-property relationships are discussed. Laboratory demonstrations of behavior in mechanical tests are included. Partially duplicates material in ESM 4024 and both should not be taken.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MSE 5154:

Processing Science In Advanced Manufacturing

Processing science. State-of-the-art manufacturing technologies. Incorporation of phase transformation, diffusion, and kinetics concepts with materials processing. Additive manufacturing (3D printing) of metals, ceramics, and polymers. Composite processing, semiconductor manufacturing, thin film processing. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MSE 5164:

Principles of Corrosion and Electrochemical Processes

Introduction to the principles of materials corrosion and corrosion

protection. Topics include: thermodynamics of materials corrosion, including potential-pH (Pourbaix) diagrams, kinetics of corrosion reactions and mixed potential theory, types of corrosion (uniform, galvanic, crevice, pitting, fatigue, stress corrosion cracking, intergranular, and hydrogen embrittlement), material/ environmental factors that promote or prevent the various types of corrosion, and methods and techniques of corrosion testing. Undergraduate physical sciences or engineering degree is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5174:

Advanced Physical Ceramics

Characteristics of vitreous and crystalline inorganic nonmetallic materials. Application and discussion of effects of composition and microstructure on thermal, mechanical, optical, electrical, and magnetic properties of ceramic products.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5200 (ECE 5200):

Semiconductor Alloys and Heterostructures

Advanced treatment of semiconductor materials with an emphasis on binary compounds, ternary and quaternary alloys, and strained-layer structures. Topics include crystal structure; lattice vibrations and phonons; energy band structure; equilibrium and non-equilibrium carrier distributions; electron and hole transport via diffusion and drift; and carrier generation and recombination mechanisms. Graduate standing required in the College of Engineering or College of Science.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MSE 3204 (UG) OR PHYS 3455 (UG) OR ECE 4214 (UG) OR MSE 3204 OR PHYS 3455 OR ECE 4214
Corequisite(s):

MSE 5234:

Introduction to the Materials Science of Surfaces and Interfaces

Fundamental and applied aspects of surfaces. Solid/solid, solid/liquid, and solid/vapor interfaces. Their structure and defects, thermodynamics, reactivity, electronic and mechanical properties. Applications depend upon class interests, but can include microelectronics, soils, catalysis, colloids, composites, environment-sensitive mechanical behavior, UHV single crystal studies, materials durability and surface bioactivity. Prerequisite: Undergraduate degree in physical sciences or engineering.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5304:

Contemporary Topics in Materials Science and Engineering

Contemporary topics in materials research selected from technical literature or recent faculty research initiatives. Topics stress the development of fundamental concepts and/or technologies of current interest to materials science and engineering. May be repeated for credit with different content for a maximum of 9 credit hours. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5334:

Advanced Applied Materials Analysis

Instrumentation, fundamentals, and practical application of characterization techniques. Scanning and Transmission Electron Microscopy, Energy Dispersive X-ray Spectrometry, Focused Ion Beam tools, Atomic Force Microscopy. Practical aspects of theory and operation of materials characterization equipment. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5384G:

Advanced Nuclear Materials

Materials for nuclear applications with emphasis on fission reactors.

Fundamental radiation effects on materials; material properties relevant to structural, moderator, reflector, blanket, coolant, control related structural systems. Pre-requisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5394:

Advanced Molecular Dynamics Simulation

Advanced molecular dynamics simulation method. Fundamental molecular dynamics principles, algorithms and components (atomic structure, periodic boundary conditions, interatomic potentials, equations of motion of atoms, statistical ensembles, integration of equations of motion). Numerical integration of equations of motion. Simulations of the time evolution of atoms, particles, or molecules under static or varying thermodynamic conditions and external loads. Connection between atom trajectories and evolution of the physical property of the simulation system with statistical mechanics principles. Hands-on case studies using LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator) molecular dynamics simulation package. Analysis and interpretation of simulation results. Prior knowledge of a programming language such as Fortran, C, C++, Matlab, Mathematica, Python, Java is highly recommended. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5504 (NSEG 5504):

Radiation Effects on Metals and Alloys

Radiation effects on metals and alloys. Interaction between particles and atoms, radiation damage, displacement of atoms, diffusion of point defects, radiation-induced segregation, phase instability, transmutation products, irradiated material mechanical properties. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MSE 4554, MSE 4564, ESM 4024
Corequisite(s):

MSE 5574G:

Advanced Biomaterials

Materials for medical applications. Basic material types and properties, functional uses of materials in medical applications, and tissue response mechanisms. Integrated design issues of multicomponent material design in prosthetic devices for hard and soft tissues, orthopedics, cardiovascular, and drug delivery applications. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5584:

Biomimetic Material Design

The application of the structure property relationships in biological materials such as wood, bone, shells, spider silk, connective tissue, blood vessels, and jellyfish as a means to design new materials. Proteins and polysaccharides, biosynthesis and assembly, biomineralization, hierarchical organization. Introduction to tissue engineering and regenerative medicine. Life cycle, environmental aspects of biofabrication. Structural characterization of biological materials. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

MSE 5614:

Advanced Nanomaterials

Synthesis of 0-dimensional nanoparticles, 1-dimensional nanotubes, nanowires, and nanorods; 2-dimensional nanoribbons and nanofilms, and specialized nano-features on substrates. Characterization of nanomaterials. Processing into higher order dimensions. Chemical, physical, mechanical, and electrical properties of nanomaterials. Application of nanomaterials.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MSE 5054
Corequisite(s):

MSE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

MSE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

MSE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MSE 5994:

Research And Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MSE 6214:

Semiconductor Nanostructures

In-depth self-consistent coverage of semiconductor nanostructures with an emphasis on low-dimensional heterostructures, such as quantum wells, quantum wires, quantum dots, and superlattices. Electronic and optical properties of nanostructures; tunneling in nanostructures; quantum phenomena in nanostructures in electric and magnetic fields; and two dimensional electron gas.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MSE 5200

Corequisite(s):

MSE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MECHANICAL ENGINEERING

Brian Lattimer, Interim Head

Emeriti Faculty: Thomas Diller; Mark Pierson;

Professors: Mehdi Ahmadian; Pinhas Ben-Tzvi; Lance Collins; Christopher Fuller; Alireza Haghighat; Andrew Kurdila; Brian Lattimer; Roop Mahajan; Rolf Mueller; Wing Fai Ng; Mark Paul; Ranga Pitchumani; Rui Qiao; Bart Raeymaekers; Corina Sandu; Chang Min Son; Danesh Tafti; Saied Taheri; Christopher Williams; Jinsuo Zhang; Michael von Spakovsky;

Associate Professors: Alan Asbeck; Oumar Barry; Bahareh Behkam; Jan Helge Bohn; Jonathan Boreyko; Jiangtao Cheng; Michael Ellis; John Ferris; Warren Hardy; Scott Huxtable; Mary Kasarda; Kevin Kochersberger; Zheng Li; Suyi Li; Yang Liu; Amrinder Nain; Shima Shahab; Steve Southward; Robert West; Alfred Wicks;

Assistant Professors: Pinar Acar; Kaveh Akbari Hamed; Michael Bartlett; Sohan Kale; Erik Komendera; Ling Li; Dylan Losey; Joseph Meadows; Noel Naughton; John Palmore; Zhenhua Tian; Alexandrina Untaroiu;

J. Bernard Jones Chair: Mehdi Ahmadian;

John R. Jones III Faculty Fellow: Michael Bartlett; Bahareh Behkam; Jonathan Boreyko; Rui Qiao;

Lewis A. Hester Chair Professor: Roop Mahajan;

Alumni Distinguished Professor Christopher C. Kraft Endowed Professor: Wing Fai Ng;

Raymond E. and Shirley B. Lynn Professorship: Rolf Mueller;

George R. Goodson Professor: Ranga Pitchumani;

Robert E. Hord, Jr. Professorship of Mechanical Engineering: Corina Sandu; Michael von Spakovsky;

William S. Cross Professor: Danesh Tafti;

L.S. Randolph Professorship of Mechanical Engineering: Christopher Williams;

Robert E. Hord Jr. Professor: Alireza Haghighat;

Adjunct Faculty: Nicole Abaid; Masoud Agah; Diana Bairaktarova; Romesh Batra; Brenda Brand; Scott Case; Shengfeng Cheng; Raffaella De Vita; William Devenport; David Dillard; Stefan Duma; Jacob Grohs; Serkan Gugercin; Andrea

L'Afflitto; Kevin Lowe; Vinh Nguyen; Robin Queen; Pradeep Raj; John Robertson; Shane Ross; Rodrigo Sarlo; Gary Seidel; Hasan Seyyedhasani; John Socha; Anne Staples; Mark Stremler; Cornel Sultan; Costin Untaroiu; Craig Woolsey; Roe Yoon;

American Society of Mechanical Engineers Fellow: Kevin Lowe;

Mary V. Jones Faculty Fellow: Ling Li;

Rolls-Royce Commonwealth Professor: Chang Min Son;

Interim Department Head: Brian Lattimer;

University Distinguish Professor Nicholas T. Camicia Professor: Roe Yoon;

Collegiate Assistant Professors: Kelly Scarff;

Collegiate Associate Professors: David Gonzales; Matthew Nowinski; Jeffrey Warfford;

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Graduate Academic Advisor, NCR: arjones@vt.edu

Graduate Financial Assistant: hjingjing@vt.edu

ME Department Site: http://www.me.vt.edu

ME Graduate Studies Guide: https://canvas.vt.edu/courses/122483

ME Research Centers & Labs: http://www.me.vt.edu/research/

Bursar's Office: http://www.bursar.vt.edu

University Scholarships and Financial Aid: http://www.finaid.vt.edu/

Timetable of Classes: https://banweb.banner.vt.edu/ssb/prod/HZSKVTSC.P_DispRequest

Medical Insurance: http://risk.controller.vt.edu/studentmedicalinsurance.html

Graduate School Funding: https://graduateschool.vt.edu/funding.html

Dates & Deadlines: http://registrar.vt.edu/dates-deadlines-accordion.html

College of Engineering: http://www.eng.vt.edu/

On Campus Housing: http://www.housing.vt.edu/

New Student Checklist: http://graduateschool.vt.edu/admissions/getting-started-as-a-student.html

Office of Veterans Services: https://www.veterans.vt.edu/

Historical Timetable of Classes: https://banweb.banner.vt.edu/ssb/prod/HZSKVTSC.P_DispHistorical

One Campus: https://onecampus.vt.edu/

Off Campus Housing: https://offcampus.vt.edu/

Student Organizations: https://gobblerconnect.vt.edu/

What You Need To Graduate: https://graduateschool.vt.edu/academics/what-you-need-to-graduate.html

The graduate programs in the ME Department at Virginia Tech provide quality mechanical engineering education through innovative research, faculty expertise, and practices that further expand and enhance students' abilities in communication and problem solving, service and leadership within their profession, industry, and higher education. The Department of Mechanical Engineering offers advanced study and research opportunities leading to PhD, MS, and MENG degrees. Each student, in cooperation with his or her advisory committee, develops a plan of study including research and course selection appropriate to the student's individual interests and research needs. Courses include (but are not limited to) topics on: acoustics, active materials/smart structures, automatic controls, biomedical topics, combustion, finite elements in machine design, fluid dynamics, fuel cell systems, heat transfer, nanotechnology, nuclear engineering, propulsion, rotor dynamics, thermodynamics, turbomachinery and vibrations. Students often take courses from outside the ME Department in mathematics, statistics, and many other disciplines. The Mechanical Engineering Department also has international collaborations with the Technische Universität Darmstadt, as well as Thapar institute of Engineering and Technology in India. VT undergraduates with high GPAs can also apply for the Accelerated Undergraduate/Graduate degree program. A Nuclear Engineering Graduate Certificate is available for students to pursue, in conjunction with their graduate degree program.

SPECIAL FACILITIES

To facilitate research, the department has specialized laboratories such as an anechoic chamber, a combustion laboratory, a computer-aided design laboratory, a fuel cells systems laboratory, a gas turbine test cell, impact biomechanics laboratory, a laser dynamics imaging laboratory, a mechatronics laboratory, a rapid prototyping laboratory, a reverberation room, and a thermal radiation laboratory among others. Many of these laboratories support one or more of the seven research centers and the more than 30 laboratory groups within the department. A list of centers and research groups are listed below, including links to the web sites if available.

MultiScale Mechanics of Advanced Materials Laboratory

Director: Prof. Reza MirzaeifarThe MultiScale Mechanics of Advanced Materials Laboratory (MultiSMArt) group uses a wide range of theoretical, computational and experimental methods at different length scales to study the mechanics of various advanced materials including shape memory alloys, carbon-based materials, biological and bio-inspired materials, composites and soft materials. Please see the Research page for more details about the active research topics in MultiSMArt.

Nuclear Materials and Fuel Cycle Center

Director: Prof. Jinsuo ZhangThe Nuclear Materials and Fuel Cycle Center (NMFC) focuses on three research topics: material degradation, nuclear coolant chemistry and purification and electrochemical separation for nuclear applications. Degradation of structural materials including fuel cladding has been recognized as one of the key factors that affect the performance of a nuclear reactor, especially for Gen.IV advanced reactors. The material degradation can be due to the corrosive property of a nuclear coolant such as liquid metal, molten salt and high temperature water or the chemical reactions between different materials such as fuel cladding chemical interactions (FCCI). Electrochemical separation has been found to be an effective method to separate nuclear materials from spent nuclear fuels and purify advanced coolant such as molten salts and liquid metals. Specifically, the center focuses on : 1) Nuclear Materials compatibility (materials corrosion/degradation), 2) Nuclear Fuel Cycle Technology; 3) Electrochemical Separation; 4)

Nuclear Safeguards and nonproliferation; and 5) Advanced Coolant (molten salt, liquid metal) chemistry and chemistry controlThe Center is equipped with following facilities/equipment:1) Flow loops for materials corrosion and coolant chemistry: Molten salt loop, high-temperature water loop, high temperature steam loop and stress corrosion cracking loop2) Glovebox systems for both radioactive and non-radioactive materials 3) Autoclave systems for in-situ corrosion measurements (molten salt, high-temperature/pressure water, liquid metal)4) High-temperature electrochemical cells for molten salt/liquid metal corrosion and chemistry5) Low-temperature electrochemical cells for water corrosion and chemistry.

Abilities, Creativity, and Ethics in Design Laboratory

Director: Diana BairaktarovaThrough real-world engineering applications, the Abilities, Creativity, and Ethics in Design Laboratory (ACE(D) Lab) experiential learning research crosses disciplines including engineering, psychology and the learning sciences, as we uncover how individual performance is influenced by abilities, personal interests and direct manipulation of physical and virtual objects. Led by Dr. Diana Bairaktarova, the ACE(D) Lab at Virginia Tech is dedicated to engineering and design education research and the engineering learner. Our interdisciplinary research focuses on the following three lines of inquiry:1. Using innovative technologies to study novel user interfaces, virtual and augmented learning and working environments that encompass human aspects at the cognitive, eye-tracking and sensory-motor levels.2. Investigating the role of individual aptitudes and abilities in performing and learning engineering through psychometric instruments and psychological interventions.3. Adopting design thinking as a philosophy (inspiration, ideation, and quick prototyping) to investigate user-centered design, empathic design and design for social innovation.

Acoustics and Functional Materials Lab

Director: Prof. Zhenhua TianAcoustic waves carry both information and energy that allow them to generate images for material evaluation as well as create invisible robotic hands (i.e., acoustic tweezers) capable of manipulating matter. The research in the Acoustics and Functional Materials Lab aims to understand the acoustic wave-matter interaction at different length scales. Second, our research focuses on developing acoustic sensing and phased array imaging technologies for applications such as structural health monitoring, bio-sensing, and biomedical imaging. Third, we work on dynamic-field acoustic tweezers that enable non-contact controllable manipulation of objects (e.g., cells, DNA, and micro/nano-particles) for manufacturing and biomedical applications (e.g., bio-printing, gene/drug delivery, and neural stimulation). Fourth, we are interested in developing meta-materials with tailored properties/functionalities as well as phononic crystals that enable versatile control (e.g., guiding, focusing, and filtering) of kHz to MHz acoustic waves.

Adhesion Mechanics Laboratory

Director: David DillardThe Adhesion Mechanics Laboratory focuses on characterizing the integrity, performance, and durability of adhesive bonds, elastomers, membranes, and other polymeric material systems. Fracture mechanics and viscoelasticity principles are applied for the experimental characterization, as well as the analytical and numerical analyses, of bonded systems. Ongoing and recent research activities have involved sponsorship from government and industrial entities, including in the aerospace, automotive, microelectronic, and consumer product areas. Materials studied include structural and pressure sensitive adhesives, fuel cell membranes, hydrogels, additive manufactured materials, and bonded wood composites.

Advanced Combustion and Energy Laboratory

Director: Prof. Joseph MeadowsThe Advanced Combustion and Energy Laboratory focuses on the research and development of next-generation combustion technologies for propulsion and power generating applications.

Advanced Control Systems Lab

Director: Andrea L'AfflittoThe Advanced Control Systems Lab (ACSL) at Virginia Tech focusses on the design of new guidance and control techniques for autonomous systems such as unmanned aerial vehicles (UAVs), robotic arms, and unmanned ground vehicles (UGVs). With its 18,000 cubic feet test cage, 3D printers, and state-of-the-art computers, ACSL provides a unique learning experience to its numerous graduate and undergraduate student and trains them to be highly competitive in the modern, fast-paced job market. Additional details about the lab director, Dr. L'Afflitto, and ACSL can be found at http://lafflitto.com.

Advanced Materials and Technologies Laboratory

Director: Prof. Ranga PitchumaniThe Advanced Materials and Technologies Laboratory (AMTL) focuses on research, development and demonstration in advancing the state-of-the-art in materials processing and manufacturing; energy systems; energy/water nexus; energy storage; and micro and nanotechnologies.

Advanced Propulsion and Power Laboratory

Co-Directors: Profs. Todd Lowe & Wing Ng Affiliated Faculty: Profs. Colin Adams, Joseph Meadows, Joseph Schetz, Changmin Son, Alexandrina Untaroiu, and Greg YoungThe Virginia Tech Advanced Propulsion and Power Laboratory (APPL) comprises state-of-the-art experimental facilities dedicated to the study of jet propulsion, propulsion integration, and the internal design of gas turbine engines and other propulsion and power systems. This laboratory spans two sites adjacent to both the Virginia Tech campus and the Virginia Tech Montgomery Executive Airport. The mission of APPL is to support and facilitate research and research education with a pathway for technology maturation and transition for aviation, defense, and power generation sponsors in government and industry.The goals of the laboratory include (1) providing laboratory facilities and an environment for collaboration among faculty, students, and researchers on turbomachinery, propulsion aerodynamics, hypersonics, and rocketry research, (2) educating students for research and development in aviation, defense, and power generation fields (3) providing value to sponsors, leading to high impact publication of research findings, and (4) exhibiting an active presence in the greater propulsion and power technical community that enhances the laboratory reputation through conference participation and professional leadership.Advanced Power and Propulsion Laboratory (APPL) is a state-of-the-art, leading-edge facility dedicated to the study of jet propulsion and the internal design of gas turbine engines and other propulsion and power systems.

Advanced Research Computing

Director: Prof. Terry HerdmanAdvanced Research Computing (ARC) provides centralized support for research computing by building, operating and promoting the use of advanced cyberinfrastructure at Virginia Tech. ARC seeks to maximize research productivity at Virginia Tech through interdisciplinary collaborations that connect researchers to new opportunities in computing and data driven research. ARC also provides a competitive advantage to VT research in obtaining external research support. Towards this end, ARC delivers a comprehensive ecosystem consisting of advanced computational systems, large-scale data storage, visualization facilities, software, and consulting services. By fostering strategic partnerships, ARC serves to cultivate advanced computing infrastructure as a platform for collaboration and helps secure the position of Virginia Tech as a leader in education, innovation, and research. ARC offers and hosts conferences, seminars, scientific computing courses and lectures catering to all levels of academia while creating a more socially inclusive environment and broadening the collective insight of the field through increased diversity.

Advanced STRuctures and Optimization (ASTRO) Lab

Director: Prof. Pinar AcarAdvanced STRuctures and Optimization (ASTRO) LabWe are interested in advanced computational problems (multi-scale modeling, design, optimization, uncertainty quantification, model reduction) for a large variety of structures (metals, metallic alloys, composites) in different length scales (molecular, meso and macro scales).

Advanced Vehicle Dynamics Laboratory

Director: Prof. Mehdi Ahmadian The Advanced Vehicle Dynamics Lab (AVDL), part of the Center for Vehicle Systems and Safety (CVeSS) at Virginia Tech, was established in 1995 by Dr. Mehdi Ahmadian, J. Bernard Jones Chair Professor of Mechanical Engineering. AVDL provides innovative and cost-effective solutions in advanced vehicle technologies toward improving the sponsors' products and market share, creates a productive environment for educating both graduate and undergraduate students, and conducts state-of-the-art research in the area of vehicle dynamics. The lab currently has several research scientists, visiting scholars, graduate research assistants, and undergraduate students. AVDL has obtained more than 10 million dollars of funded research in vehicle dynamics and control.

Assistive Robotics Laboratory

Director: Prof. Alan AsbeckThe Assistive Robotics Laboratory (ARL) focuses on developing human-assistance devices and on understanding how to make them work most effectively with the body. The goal is to help people to regain capabilities they have lost, or enable people to perform feats that were not previously possible.

Autonomous Systems and Intelligent Machines Laboratory

Director: Prof. Azim EskandarianThe Autonomous Systems and Intelligent Machines Laboratory (ASIM) is established to conduct research in controlling multiple mechanical/electromechanical systems (robots, vehicles, mechanisms) to operate either autonomously or semi-autonomously in coordination with humans. We take advantage of intelligence created by a host of sensors, connectivity through communications, and advanced controls and learning algorithms. We also attempt to learn from biological systems and human brain functions, through signal processing, to mimic intelligent motor control. Our current focus is on coordinated control of communication enabled mobile robots and vehicles with various on-board sensors which are linked to other robots/vehicles and surrounding environment. Our mobile robots emulate autonomous and connected vehicles with communications of vehicle-to-vehicle (V2V), Vehicle-to Infrastructure (V2X) and Vehicle to other entities such as road users, pedestrians, bicyclists, etc. We are developing and evaluating hybrid hierarchical control algorithms for autonomous driving, platooning, merging, and several other dynamic coordinated functions of intelligent vehicles and robots in complex environments. A second area of focus is on driving safety dealing with Advanced Driver Assistance Systems (ADAS) and active safety systems. We seek to understand driver cognitive perception-response abilities through human brain and physiological monitoring and modeling motor/control actions. The in-depth understanding of the driver's perception-response to external stimuli enables development of more coherent ADAS, thus leading to more intelligent vehicles. These vehicles better interact with drivers and support driving functions automatically as a continuously supporting co-pilot. Driving, due to its complexity and involvement of continuous sensing, decision making, and perception-response tasks, is a suitable test bed for human brain monitoring and investigation. However, our research discoveries would be similarly useful and applicable to other brain-controlled tasks and functions such as limb control, patient rehabilitation, or brain control of machines.

Batra Computational Mechanics Laboratory

Director: Romesh BatraThe Batra Computational Mechanics Laboratory at Virginia Tech specializes in the development of mathematical and computational models of nonlinear and multi-physics phenomena that involve thermal, mechanical, viscous and electrical effects in elastic (e.g., rubber like, and biological materials), elastic-plastic (e.g., ceramics, metals, polymers), and thermo-visco-elasto-plastic materials under extreme loads such as those caused by improvised explosive devices and slamming of a boat into water (i.e., fluid-structure interaction). The group studies the initiation and progression of damage and failure in monolithic and composites including sandwich structures with fiber-reinforced

Center for Bioinspired Science & Technology

Director: Prof. Rolf MuellerThe Center for Bioinspired Science & Technology (BIST) is an interdisciplinary research center at Virginia Tech that is dedicated to the study of biological function from an engineering perspective. The goal of the research is to create novel technology based on insights obtained from biological model systems that continue to outperform their man-made peers. Within the BIST Center, Dr. Mueller's team uses a combination of soft-robotics and deep learning to understand and replicate the function of the biosonar system in bats. If successful, this research could lead to new technologies for realizing autonomy in complex natural environments.

Center for Energy Harvesting Materials and Systems

Director: Prof. Lei ZuoThe Center for Energy Harvesting Materials and Systems (CEHMS) is a National Science Foundation (NSF) Industry-University Collaborative Research Center with sites at Virginia Tech, Columbia University and Penn State University. Working on both fundamental and applied research, CEHMS aims at developing interdisciplinary strengths and integrated solutions for energy harvesting and applications, using the principles of vibration and dynamics, mechatronics design, control systems, fluid mechanics, smart/functional materials, advanced manufacturing, and power electronics. The recent focus of CEHMS is on marine renewable energy (wave, tidal, current, riverine), offshore wind energy, intelligent vehicle and transportation, self-powered control, and energy-sustainable sensors.

Center for Energy Systems Research

Director: Prof. Michael von SpakovskyThe mission of the Center for Energy Systems Research (CESR) is to conduct both fundamental and applied research into all aspects of energy systems and their components whether for transportation, stationary, or portable applications. Single disciplinary and multidisciplinary research includes analytical, numerical, and experimental modeling from the atomistic to the large-scale system levels. In addition, faculty develop and teach energy-based courses both at the undergraduate and graduate levels as well as short courses on various topics such as, for example, non-equilibrium thermodynamics, fuel cells, building energy systems, hybrid electric vehicles, etc.

Center for Injury Biomechanics - Virginia Tech/Wake Forest

Director: Prof. Warren HardyThe Center for Injury Biomechanics (CIB) performs research investigating human tolerance to impact loading. The application of this research includes automobile safety, military restraints, and sports biomechanics.

Center for Tire Research

Director: Prof. Saied TaheriThe Center for Tire Research (CenTiRe) is an NSF Industry/University Cooperative Research Center (I/UCRC) which focuses on supporting a research program in tire materials, modeling, manufacturing, and testing combined with rubber material prototyping and testing, and parallel computing and dynamic simulation capabilities. Our two world-class university sites, Virginia Tech and the University of Akron, have the expertise and facilities to perform the research requested by our industry members. They also serve as an excellent training ground for students to enter industry. Our industry members are at core of the Center through involvement in the Industry Advisory Board, setting the operating procedures and direction of research to be carried out by the Center. These members come from the tire, vehicle, materials, and testing industries. They cooperatively propose and select the research to be conducted, fund the work through their combined annual membership fees, mentor the ongoing work, and share in the results. This process facilitates the transfer of technology from the university to the industry members, as well as linking the companies to graduate students as potential interns and future employees.Research already conducted by CenTiRe for our members has spanned the range from molecular level filler/polymer interaction, improved compounding, material characterization, durability testing and simulation, tire/road/ice interactions, radiated noise, intelligent tire, and tire/vehicle/road surface simulations. Many of our graduated students who gained experience in these Center-funded projects are now working in our member companies.CenTiRe looks to continue to grow, both in its industry memberships and by adding universities with expertise that complement our already existing capabilities to better perform tire and tire-related research for our members.

Center for Unmanned Aircraft Systems

Co-Directors: Prof. Craig Woolsey & Kevin KochersbergerThe Center for Unmanned Aircraft Systems (C-UAS) is an Industry/University Cooperative Research Center whose members include Brigham Young University, the University of Colorado at Boulder, Virginia Tech, and the University of Michigan. The center is the only National Science Foundation-funded unmanned aircraft research center to provide innovative solutions to key technical challenges and superb training for future leaders in the unmanned aircraft systems industry.

Center for Vehicle Systems & Safety

Director: Prof. Mehdi AhmadianThe Center for Vehicle Systems and Safety (CVeSS) at Virginia Tech was established in 2004 by Dr. Mehdi Ahmadian, J. Bernard Jones Chair Professor of Mechanical Engineering and Director of CVeSS. The Center consists of two laboratories: Advanced Vehicle Dynamics Laboratory (AVDL, established 1995) and Railway Technologies Laboratory (RTL, established 2004). The center is served by a large number of faculty members, research scientists, visiting scholars, graduate students, and undergraduate students, who support a diverse portfolio of projects. CVeSS conducts state-of-the-art fundamental, scientific, and experimental research in the area of road, rail and marine vehicles. It provides innovative and cost-effective solutions in our area of expertise to improve our sponsors' technologies, products and market share, and creates a productive environment for educating students to better serve their future employers.

Cheng Computational and Theoretical Soft Matter Laboratory

Director: Prof. Shengfeng ChengThe Cheng Computational and Theoretical Soft Matter Laboratory group is mainly interested in soft condensed matter systems, including both biological and synthetic polymers, nanoparticles, and nanocomposites. Researchers in the group use molecular dynamics simulations and theoretical models based on statistical mechanics to study phenomena including supramolecular/supramacromolecular self-assembly, nanoparticle self-assembly, evaporation, wetting, adhesion, friction, and crumpling phenomena.

Collaborative Robotics Lab

Director: Prof. Dylan LoseyWelcome to the Collaborative Robotics Lab (Collab) at Virginia Tech! We create learning and control algorithms for robots that collaborate with people. Our goal is to develop intelligent robots that understand — and are understood by — their human partners. These robots personalize their behavior: continually adapting to what the human wants and proactively helping them to achieve their goals. Overall, our research explores the intersection of human-robot interaction, machine learning, and control theory, with applications in personal, interactive, and assistive robots.

Combustion, Atomization, & Multiphase Physics Research Group

Director : Prof. John Palmore JrThe Combustion, Atomization, & Multiphase Physics Research (CAMPhyRe) Group develops high-fidelity numerical methods to study turbulent multiphase flows with special emphasis on combustion and energy conversion systems. We study topics including fuel spray combustion and foreign object damage (particle motion and impact). In developing our numerical methods we rely heavily on massively parallel, high performance computing techniques to accelerate our code. As such, our work lies at the nexus of engineering, mathematics, and computer science. We leverage high performance computing resources at Virginia Tech Advanced Research Computing Center to perform our work.

Complex Systems Lab

Director: Nicole Abaid Our research focuses on the dynamics and control of multi-agent systems with real-world applications. Current projects include modeling and control of animal group behavior, neural networks, and collaborative human-robot teams.

Design, Research & Education of Additive Manufacturing Systems Laboratory

Director: Prof. Christopher WilliamsThe research mission of the Design, Research & Education of Additive Manufacturing Systems Laboratory (DREAMS) is to advance the materials and processes of Additive Manufacturing technologies (commonly referred to as "3D Printing"). Researchers blend computer-aided design, mechatronics, manufacturing science, and materials science to gain fundamental understanding of process-property-structure relationships and to create new objects with unparalleled performance that could not be achieved through any other means. With access to every modality of additive manufacturing, DREAMS Lab students are able to push the boundaries of today's machines to process tomorrow's materials.

Dynamic Matter Research Lab

Dynamic Matter Research LabDirector: Prof. Suyi LiOur lab's long-term research vision is to foster a new paradigm of structures and material systems with programmable properties" and "physical intelligence. We refer to them as the "dynamic matter," and they could take up a variety of forms and functions: such as mechanical metamaterials that can adapt their responses on-demand; soft robot bodies that can perform control tasks with minimal or even no electronics; or large-scale architectural components that can react to ambient environmental changes intelligently. We firmly believe that this dynamic matter concept can cross-pollinate with many different disciplines — within and outside of mechanical engineering — and fundamentally advance our strategic industries like aerospace, bio-medicine, manufacturing, and robotics.To build these dynamic matters, we take an integrated approach encompassing optimal design, theoretical analysis, and experimental validation. In particular, we focus on creating and harnessing unorthodox relationships between geometry and dynamics, taking many inspirations from art and nature like origami folds and plant tissue physiology. We believe that these geometries can be used to architect new dynamics and open avenues toward our long-term vision.

Energy Harvesting and Mechatronics Research Laboratory

Director: Prof. Lei ZuoThe Energy Harvesting and Mechatronics Research Laboratory conducts applied and fundamental research in energy harvesting, vibration control, mechatronics design, vehicle dynamics, thermoelectric materials, smart structures, and advanced sensors. Multi-disciplinary approaches are taken to address the challenges on large scale energy harvesting (from ocean wave, wind, etc.), energy harvesting for self-power control (vehicles and civil structures), energy harvesting for autonomous sensors and IoTs, and advanced manufacturing of energy harvesting materials.

Energy Storage Systems Design and Manufacturing Laboratory

Director: Prof. Zheng LiEnergy Storage Systems Design and Manufacturing Laboratory focuses on research and education in the design and advanced manufacturing of energy storage systems. The mission is to enable wider adoption of energy storage technologies for transportation and electrical grid with no disruption to the critical materials supply chain. Multidisciplinary research activities include long-duration energy storage systems for electrical grids, cyber-enabled automatic lithium-ion battery recycling, combinatorial energy storage materials synthesis and characterization. Dr. Li develops and teaches undergraduate and graduate-level courses on Energy Storage Systems Design and Manufacturing, and Industrial Internet of Things Platform.

Extreme Environments and Materials Laboratory

Director: Prof. Brian LattimerIn the Extreme Environments and Materials Laboratory (Extreme Lab) We explore the environment produced by hazards, impact of that environment on materials and systems, development of sensing/diagnostics to quantify the behavior, and creation of technology for improved performance in field applications.

Future Materials Laboratory

Director: Prof. Reza MirzaeifarFuture Materials Laboratory group uses a wide range of experimental, theoretical, and computational methods at different length scales to study the mechanics of various advanced materials including 3D printed (Additively Manufactured) metals, Metal-Graphene Composites, Shape Memory Polymers, and biological/bio-inspired materials. Please see the group page for more details about the active research topics in Future Materials Lab.

Granata Biomechanics Lab

Director: Dr. Robin Queen Kevin P. Granata Biomechanics Lab (Granata Lab) studies changes in movement mechanics that result from injury and surgical interventions. In addition, we work to design and test new technologies for the assessment of movement and load distribution in non-laboratory systems and we are beginning to collaborate to advance assessment methods in in-home settings.

High Performance Computational Fluid Thermal Science and Engineering Lab

Director: Prof. Danesh TaftiThe High Performance Computational Fluid Thermal Science and Engineering Lab focuses on research in the advancement and application of computational methods and tools to aid the physical understanding and design of fluid-thermal systems. The lab's research spans methods and software development on supercomputers, jet propulsion, renewable energy, biological and biomedical systems.

Hybrid Dynamic Systems and Robot Locomotion Laboratory

Director: Kaveh Akbari Hamed The Hybrid Dynamic Systems and Robot Locomotion (HDSRL) lab aims to establish a firm foundation to create innovative algorithms to systematically design resilient and intelligent controllers for a wide range of dynamic systems with nonlinear and hybrid nature. These systems include, but are not limited to, (1) autonomous robots for disaster response and industrial applications, (2) cooperative multiagent systems with decentralized and distributed control policies, (3) walking and running robots with human/animal morphology, and (4) complex systems.

Intelligent Transportation Laboratory

Director: Prof. Saied TaheriThe mission of the Intelligent Transportation Laboratory (ITL) is to improve the road transportation safety through development and application of the state-of-the-art sensors, actuators, and control systems.

Laboratory for Graphene-X and Thermal Engineering

Director: Prof. Roop L. MahajanThe laboratory houses a facility for synthesis of graphene from coal and graphite. It includes a probe-type ultra-sonicator, a centrifuge machine, three chemical hoods, high-energy ball-milling device and conventional ball-milling and other related characterization and testing equipment. The laboratory is also a home to experimental rigs for measurement of thermal conductance and convective transport in interface materials and high porosity foams.

Laboratory of Transport Phenomena for Advanced Technologies

Director: Prof. Rui QiaoThe Laboratory of Transport Phenomena for Advanced Technologies focuses on atomistic, mesoscopic, and continuum simulation of transport phenomena including fluid, ion, thermal, and particulate transport. These researches are driven by challenges emerging at the frontiers of advanced technologies such as dewatering, turbine engine protection, electrical energy storage, and thermal management.

Manufacturing and Tribology Laboratory

Manufacturing and Tribology Laboratory Director: Prof. Bart Raeymaekers The Manufacturing and Tribology Laboratory is active in two areas: advanced manufacturing of complex mechanical systems, materials, and devices and tribology with an emphasis on micro- and nanoscale lubrication. Our research finds application in manufacturing of novel engineered polymer composite materials, micro- and nanoscale surface engineering, manufacturing of prosthetic implants, and tribology of additive manufacturing.

Mechanics of Complex Materials Lab

Director: Prof. Maryam ShakibaMechanics of Complex Materials Lab (MCML). We use theoretical and computational mechanics to unravel the link between the composition, microstructure, and performance of complex and advanced materials under different extreme environmental and mechanical loadings. This integration of computational techniques and material sciences provides engineers and researchers a tool to design sustainable, multifunctional, and additively manufactured systems.

Mechanics of Living Material Lab

Director: Prof. Sohan KaleThe Mechanics of Living Materials Lab studies emergent behaviors in cells and tissues with a multiscale materials approach. We develop theoretical and computational models for active, dynamic, and coupled mechano-bio-chemical behaviors on subcellular, cellular, and tissue scales relevant in physiology, health, and diseases.

Micro/NanoScale Biotic/Abiotic Systems Engineering Laboratory

Director: Prof. Bahareh BehkamMicro/NanoScale Biotic/Abiotic Systems Engineering (MicroN BASE) laboratory's interest is in experimental and theoretical investigation of phenomena at the interface of biological and synthetic systems at the micro and nanoscale. Current research activities are: (1) Developing bio-hybrid micro-robotic systems in which biological components are utilized for actuation, sensing, communication, and control (e.g. bacteria-enabled autonomous drug delivery systems for cancer therapy) (2) Studying mechanism of adhesion, motility and sensing in mammalian cells and unicellular microorganisms (e.g. effect of surface nano-topography on fungal biofilm formation). We utilize 2D and 3D microfluidic platforms to establish well-defined and repeatable test environments for most of our projects.

Multiphase Flow and Thermal-hydraulics Laboratory

Director: Prof. Yang LiuThe Multiphase Flow and Thermal-hydraulics Laboratory (MFTL) performs experimental and computational studies on various multiphase flow and reactor thermal-hydraulics topics. In the first area, we study the full spectrum of two-phase flow regimes that are of practical interest, ranging from bubble nucleation to film and droplet dynamics. Research activities include advanced instrumentation development, experimental studies, and model development for both 1-D system codes and 3-D CFD codes. In the area of reactor thermal-hydraulics, the focus is on reactor safety related issues. Specific topics include air entrainment in the emergency core cooling system, flow structure development in rod bundles, flow induced vibration on piping elements, passive safety systems, and spent fuel pool safety. MFTL has several test loops for two-phase flow experiment and instrumentation development. These test loops are equipped with high-precision instruments including magnetic flow meters, air mass flow meters, and differential pressure transducers. An existing high-speed imaging system consists of multiple (up to five) high-speed cameras, with an attainable frame rate up to 500,000 fps and resolution up to 6016x1024 pixels. A fast X-ray line-detector system can provide X-ray imaging at spatial resolution of 100 micrometer and a frame rate exceeding 1000 Hz. MFTL also has the capability to develop in-house instrumentation systems, such as multi-sensor conductivity probes, impedance void meters, and film thickness sensors. The dedicated computing resources include a 64-core AMD Opteron workstation and several multi-core Intel Xeon based workstations. The lab has access to Virginia Tech's high-performance computing systems, which houses more than five high performance clusters and necessary software packages including ANSYS CFX, ANSYS FLUENT and OpenFOAM, to perform single- and multi-phase CFD simulations.

Multiphysics Intelligent and Dynamical Systems (MInDS) laboratory

Director: Shima Shahab The theoretical and experimental research program at Multiphysics Intelligent and Dynamical Systems (MInDS) laboratory focuses on the structural dynamics and wave propagation in ultrasound-responsive intelligent material systems. The various interdisciplinary applications include wireless acoustic power transfer, acoustic holographic lenses, ultrasound atomization, microfluidics driven via ultrasonic, and ultrasound responsive polymer-based systems.

Nature-Inspired Fluids & Interfaces

Director: Jonathan Boreyko The Nature-Inspired Fluids & Interfaces laboratory (NIFI) studies novel materials and phenomena exhibited by animals, plants, and the environment. We then exploit these to design innovative technology, with a focus on advanced materials, water harvesting, and renewable energy. For example, building synthetic trees that mimic the transpiration cycle of natural plants, to collect fresh water or for energy generation. Our research is a multi-disciplinary combination of fluids dynamics, phase-change heat transfer, materials science, and thermodynamics.

Ng Laboratory

Director: Prof. Wing Ng The Ng Laboratory is a state-of-the-art research facility dedicated to advancing the core technologies and capabilities of aerospace propulsion and ground-based power generation. It is part of the Advanced Power and Propulsion Laboratory which houses four test cells and a fundamental research laboratory with a number of experimental rigs that simulate the flow and thermal conditions throughout propulsion engines and gas turbines.

Nonlinear Systems Laboratory

Director: Prof. Craig WoolseyThe Nonlinear Systems Laboratory (NSL) in the Aerospace and Ocean Engineering Department at Virginia Tech provides a facility for research and instruction indynamics and control of nonlinear systems, with particular focus on autonomous ocean and atmospheric vehicles. Founded in 2005, the NSL is co-directed by Dr. Cornel Sultan, Dr. Mazen Farhood, and Dr. Craig Woolsey. The Lab supports Virginia Tech's Autonomy and Robotics group.

Nuclear Science and Engineering Laboratory

Director: Prof. Alireza HaghighatThe Nuclear Science and Engineering Laboratory (NSEL) is a unique research laboratory strategically located within a regional triangle of the Virginia Tech Research Center (VTRC) at Arlington, the Virginia Tech Campus in Blacksburg, and the Center for Advanced Engineering and Research (CAER), an industry-based research hub in New London, Virginia. Under the auspices of the Institute for Critical Technology and Applied Science (ICTAS), NSEL facilitates collaboration among its members and government agencies, industrial organizations, and educational institutions. It draws the expertise of faculty members from different disciplines and promotes nuclear education by offering workshops, courses, and seminars. NSEL enables the VT Nuclear Engineering Program to fill a void in nuclear education and research in the National Capital Region. It is expected that NSEL activities will lead to establishment of new centers, vigorous research activities, engagement in nuclear policy development, and innovations of new tools and devices and computational tools for application in nuclear power, nuclear security and safeguards, and radiation diagnosis and therapy. NSEL will contribute to enhancing nuclear education in the NCR, and training of the next generation nuclear scientists and engineers. In August 2015, NSEL signed an agreement with the US Naval Academy (USNA). Under this agreement, VT faculty and students engage with the USNA midshipmen and faculty in joint research and educational activities and benefit from the nuclear facilities at USNA.

Performance Engineering Research Laboratory

Director: Prof. Steve SouthwardThe mission of the Performance Engineering Research Laboratory (PERL) is to enhance the performance of sport, military, industrial, and commercial vehicles with the development and application of innovative active & adaptive control strategies. Our goal is to advance the state-of-the-art in vehicle suspension design, testing, and optimization with breakthrough innovations for improving vehicle ride and handling.

Robotics and Mechatronics Laboratory

Director: Prof. Pinhas Ben-TzviThe Robotics and Mechatronics Laboratory's mission is to conduct advanced fundamental and applied research in robotics, intelligent autonomous systems, robotic vision and visual serving/odometry, machine learning, human-robot interactions, mechatronics design, systems dynamics and control, mechanism design and system integration, and novel sensing and actuation. Examples of research application areas and projects include autonomous mobile robots with symbiosis of locomotion and manipulation and modular and reconfigurable mobile robotics for search & rescue and hazardous environment sensing and monitoring; intelligent bio-inspired robotic tails for robust dynamic stabilization and agile maneuvering of legged robots on rough terrain; haptics devices and upper-extremity exoskeletons for tele-operation and rehabilitation; autonomous unmanned aerial vehicle (UAV) launch and recovery from naval vessels; advanced medical devices and robotic systems for precision surgery; and novel smart sensors and actuators for biomedical applications.

Ross Dynamics Laboratory

Director: Prof. Shane RossThe Ross Dynamics Laboratory at Virginia Tech specializes in applications of nonlinear dynamics, performing mathematical modeling, simulation, visualization, and experiments with applications in several different fields, including: patterns of dispersal in oceanic and atmospheric flows, passive and active aerodynamic gliding, dynamic buckling of flexible structures, transport across the air-water interface, orbital mechanics, chemical physics, and causality analysis in complex natural and artificial systems.

Soft Materials and Structures Lab

Director: Prof. Michael D. Bartlett The research in the Soft Materials and Structures Lab lies at the intersection of soft materials, mechanics, and functionality. Through precise experiments and analyses, we study and exploit the fascinating interplay between material composition, geometry, and programmed deformations. This interdisciplinary and biomimetic approach aims to create advanced, multifunctional materials with novel combinations of mechanical and functional properties, including ‘smart’ adhesives, deformable electronics and soft robotics, and adaptive materials.

Spinneret based Tunable Engineered Parameters Laboratory

Director: Prof. Amrinder NainThe Spinneret based Tunable Engineered Parameters (STEP) is a pseudo dry spinning technique that allows the deposition of nano-micron sized diameter fibers with user defined control of diameter, spacing, and deposition angle.

Terramechanics, Multibody, and Vehicle Systems Laboratory

Director: Prof. Corina SanduThe Terramechanics, Multibody, and Vehicle Systems (TMVS) Laboratory educates students and conducts research in a broad range of fundamental and applied topics in the three main areas mentioned in its name: terramechanics (vehicle-terrain interaction, tire/track modeling, vehicle mobility, soil/terrain modeling), multibody systems (modeling, simulation, uncertainty quantification, parameter estimation, sensitivity analysis, design optimization), and vehicle dynamics (tire dynamics, suspension modeling; handling, ride, and performance analysis).

Terrestrial Robotics and Control Laboratory

Director: Prof. Alex LeonessaThe Terrestrial Robotics and Controls Laboratory (TREC) at Virginia Tech is a facility for graduate and undergraduate robotics research and education with an emphasis on studying novel mobile robot locomotion strategies, such as bipedal, quadrupedal, and soft robotics. Potential areas of application are exoskeletons for rehabilitation and performance enhancement, search and rescue, precision agriculture, just to mention a few.

Theoretical and Applied Fluid Mechanics Group

Director: Mark A. StremlerThe Theoretical and Applied Fluid Mechanics (TAFM) Group conducts research on a range of topics in fluid mechanics, including reduced-order mathematical, numerical, and experimental models of fluid flows, with an emphasis on fluid-structure interaction, flows dominated by coherent vortical structures, microfluidic systems, fluid dynamics in biological systems, and connections to dynamical systems theory, particularly applications to fluid mixing.

Unmanned Systems Laboratory

Director: Prof. Kevin KochersbergerThe Unmanned Systems Laboratory brings together a diverse collection of researchers to a common facility dedicated to autonomous and remotely operated systems development and integration.

VT Railroad Advanced Initiatives Laboratory

Director: Prof. Mehdi AhmadianThe Railway Technology Laboratory (RTL), part of the Center for Vehicle Systems and Safety (CVeSS) at Virginia Tech, was established in 2004 as an Association of American Railroads (AAR) affiliated laboratory. Dr. Mehdi Ahmadian, J. Bernard Jones Chair Professor of Mechanical Engineering, is the founding director of RTL. RTL explore advanced technologies for the railroads and their suppliers to be more efficient and competitive in their day-to-day operations, conduct state-of-the-art scientific and experimental research in railroad and rail vehicles, and create a productive environment for educating both graduate and undergraduate students to better serve their future employers. Currently, RTL is a member of consortium (called “RailTEAM”) of Virginia Tech, UNLV, and the University of Delaware, which is the only DOT University Transportation Center (DOT-UTC) in rail transportation.

Vehicle Terrain Performance Laboratory

Director: Prof. John FerrisThe mission of the Vehicle Terrain Performance Lab (VTPL) is to improve vehicle system performance by studying the interactions between vehicles and terrain.

Veterinary-Medicine Sensor Development Group

Director: Dr. Mary Kasarda (maryk@vt.edu)Our group explores the development of non-invasive sensing approaches, such as the application of computer-vision and acoustic measurement techniques, for monitoring animals in veterinary-medicine and animal-care scenarios to help support improvements in the health and well-being of animals. For example, our research in computer-vision applications lays the groundwork for robust tool development for noninvasively monitoring horses, and without the required presence of humans, in such applications as post-operative monitoring, foaling, evaluation of performance horses in competition, as well as for providing quantitative data for research on animal behavior and welfare, among other scenarios. Dr. Kasarda is an affiliate faculty in the CENTAUR Center in the Virginia-Maryland College of Veterinary Medicine at Virginia Tech.

Vibrations & Acoustics Laboratory

Director: Prof. Christopher FullerThe Vibrations and Acoustics Laboratory's (VAL) mission is to devote our research staff and facilities to the solution of major scientific problems in vibrations and acoustics and to improving the quality of life as far as noise pollution, in the communities that we serve. One of our primary goals is to develop seminal new knowledge and solutions to difficult problems in sound and vibration. In addition, we aim to provide a foundation of knowledge, expertise and leadership in the field of sound and vibration control.

Virginia Tech Microelectromechanical Systems Laboratory

Director: Prof. Masoud AgahVirginia Tech Microelectromechanical Systems Laboratory (VT MEMS Lab) The current research at VT MEMS Lab centers on the development of CMOS-compatible three-dimensional silicon micro-machining techniques, smart microchip coolers, micro gas analyzers for environmental and healthcare applications, and bio-chips for cancer diagnosis and cancer treatment monitoring. In addition, the lab is pursuing research to merge MEMS (top-down approach) and nanotechnology (bottom-up approach) in order to enhance the performance of the micro-systems under development in our group.

Visionarium

Visionarium Laboratory for virtual 3-D visualization was upgraded in June 2016, with a new immersive projection system: the HyperCube. Like the CAVE and VisCube before it, the HyperCube has three rear-projected ten foot square walls and a top-projected floor with a cutout hiding a MOOG motion platform. The HyperCube features numerous hardware and software upgrades to increase the performance and fidelity of the visualization, including: more pixels (2560×2560 active stereo per wall), more brightness, more contrast, surround sound, as well as a new optical tracking system. The HyperCube is connected to the ARC clusters using the 10Gbps VT-RNet. Numerous scientific visualization, 3D authoring, conversion, and publishing software are available on PID-accessible Lab workstations.

DEGREES OFFERED

MEng Degree

Offered In (Hampton Roads, Blacksburg, National Capital Region)

TOEFL

iBT: (105.0)

IELTS

English Proficiency: (7.0)

The MEng program seeks to educate graduate engineering students by delivering a broad-based theoretical curriculum developing students' ability to address specific engineering problems in order to enhance industry and the technical community. Please contact megrad@vt.edu for specific location information. Acceptance into the VT Mechanical Engineering graduate program is based on the overall application package. In general, the minimum target requirements are to the left. The application materials required can be accessed from the ME Graduate Students web page. Master of Engineering (MENG) Degree Requirements The Master of Engineering Degree (MENG) in Mechanical Engineering is primarily intended for individuals working in industry/government, and pursuing this degree on a part-time basis. Students must complete a minimum of 30 semester hours of technical graduate study beyond the baccalaureate, not including supporting courses. Because the MENG requires more technical coursework hours (24) and only project hours (6), departmental funding is not available. MENG students must submit a proposed Plan of Study to the Graduate Coordinator & Academic Advisor before completing the first semester registered as a MENG student. An official final plan of study is due by the end of the second semester. The Master of Engineering Degree in Mechanical Engineering must include the following minimum requirements: 1. Project and Report (ME 5904): 6 hours minimum2. Approved technical coursework meeting the following: 24 hours minimum Courses numbered 5000, or higher: 18 hours minimum ME Technical Course Work: 9 hours minimum Courses outside the student's specialization area: 6 hours minimum ME approved Mathematics or Statistics: 3 hours minimum A maximum of two Virginia Tech 4000 level courses are allowed to meet degree requirements and should be on the ME Technical Elective List for undergraduate ME students. If it is a conjoint course, it must be taken at the 5000 level. A maximum of 6 hours of Special Study (5984 only), and a maximum of 6 hours of Independent Study (5974 only), with the total of both not to exceed 9 hours is allowable. Transfer courses meeting Graduate School policies, are listed and approved on the official Plan of Study. Official transcripts and course descriptions are required. The Graduate School requires a Diversity and Inclusion component for all graduate students. EngE 5304 Graduate Student Success in a Multicultural Environment meets this requirement and is listed as a supporting course on the plan of study.Seminar Program: All full-time Blacksburg students must participate in the Mechanical Engineering seminar series each semester by registering in ME 5944. These hours are not counted towards technical course requirements and are not listed on the plan of study.Ethics: All graduate students must meet the Graduate School's Ethics requirement by completing CITI Training modules on Canvas or, the supporting course, GRAD 5014 Academic Integrity & Plagiarism, within their first 2 semesters. A written Project & Report is required for the Final Defense. No courses below the 4000 level are accepted to meet graduate degree requirements. Contact the ME graduate program for approval procedures before taking any Independent Study (5974 only) courses. Summer registration is not required for continuing students.

Degree Concentrations:

Nuclear Engineering Graduate Certificate

A student must take a total of at least 9 credit hours with a letter grade of 'B' or better in every course to obtain the Nuclear Engineering Graduate Certificate. Six credit hours from 5000-level courses or, higher are required. More information is available in the Graduate Catalog.Required: NSEG 5114 Nuclear Engineering Fundamentals: 3 creditsElectives: Minimum 6 credit hours from the approved course list (at least 3 credithours at the 5000-level or higher)

PhD Degree

Offered In (Hampton Roads, Blacksburg, National Capital Region)

TOEFL

iBT: (105.0)

IELTS

English Proficiency: (7.0)

The PhD program seeks to prepare graduate students to think critically by generating a novel engineering research problem and using their technical competence to craft and conduct experimentation leading to research methodology from concept to completion. Students will present their research as the leading expert in the research field and will contribute publications, innovative research, and other scholarly activities to benefit the global community.Please contact megrad@vt.edu for specific location information. Acceptance into the VT Mechanical Engineering graduate program is based on the overall application package. Admission does not guarantee financial assistance. In general, the minimum target requirements are to the left. The application materials required can be accessed from the ME Graduate Students web page. Doctor of Philosophy (PhD) Degree Requirements The Doctor of Philosophy (PhD) in Mechanical Engineering requires students to complete a minimum of 90 semester hours of technical graduate credits (with stipulations listed below) beyond the baccalaureate, pass a qualifying exam, preliminary exam, and complete a research dissertation. PhD students must submit a proposed Plan of Study before completing the second semester registered as a PhD student to the Graduate Coordinator & Academic Advisor. A final official Plan of Study is due the third semester. Much of the course work from the Masters degree is allowed towards the PhD. The Plan of Study must meet the following minimum requirements: Research & Dissertation (7994): 30 hours minimum Approved technical VT ME graduate courses: 15 hours minimum Additional approved technical graduate courses: 15 hours minimum Additional hours of either research (7994) or technical coursework: 30 hours minimum Technical courses numbered 5000, or higher: 27 hours minimum Students are allowed a maximum of two Virginia Tech 4000 level courses in numbers 2 and 3 above to meet course requirements. These courses must be on the Technical Elective List for undergraduate ME students. If it is a conjoint course, it must be taken at the 5000 level. ME approved Mathematics or Statistics: 3 hours post baccalaureate For continuously enrolled VT students completing an MS first, most or all coursework counts towards the PhD. Transfer courses (including from a non-VT MS degree) meeting Graduate School policies, are listed and approved on the official Plan of Study. Official transcripts and course descriptions are required. Independent/Special Study Courses (5974 and 5984): 12 hours maximum The Graduate School requires a Diversity and Inclusion component for all graduate students. EngE 5304 Graduate Student Success in a Multicultural Environment meets this requirement and is listed as a supporting course on the plan of study.Seminar Program: All full-time Blacksburg students must participate in the Mechanical Engineering seminar series each semester by registering in ME 5944. These hours are not counted towards technical course requirements and are not listed on the plan of study.Ethics: All graduate students must meet the Graduate School's Ethics requirement by completing CITI Training modules on Canvas or, the supporting course, GRAD 5014 Academic Integrity & Plagiarism, within their first 2 semesters. No courses below the 4000 level are accepted for graduate credit. Contact the ME graduate program for approval procedures before taking any Independent Study (5974 only) courses. Summer registration is not required for continuing students. In addition, matriculating doctoral students must pass the PhD Qualifying exam within their first 3 semesters, as well as passing a Preliminary Exam/Proposal Defense at least 6 months prior to the Final Defense. A written Dissertation is required for the Final Defense. Please refer to the ME Graduate Handbook for more information about the PhD Qualifying exam. Direct PhD MS Students may skip the MS and enroll as a "Direct-PhD" by securing a PhD Research Faculty Mentor. All PhD requirements are the same as listed above.

Degree Concentrations:

Nuclear Engineering Graduate Certificate

A student must take a total of at least 9 credit hours with a letter grade of B or better in every course to obtain the Nuclear Engineering Graduate Certificate. Six credit hours must be from 5000-level courses or higher. More information is available in the Graduate Catalog.Required: NSEG 5114 Nuclear Engineering Fundamentals: 3 creditsElectives: Minimum 6 credit hours from the approved course list (at least 3 credithours must be at the 5000-level or higher)

MS Degree

Offered In (Virtual, Hampton Roads, Blacksburg, National Capital Region)

TOEFL

iBT: (105.0)

IELTS

English Proficiency: (7.0)

The thesis MS program is offered in-person and seeks to prepare graduate students by providing them with practical and theoretical engineering knowledge. The thesis MS program trains students to become technical leaders, design a research methodology which solves an existing engineering problem, present on their research, and contribute to the scholarly work of the global mechanical engineering community. The non-thesis MS program is available virtually. The non-thesis MS seeks to educate graduate engineering students by providing them with preparation in the essential sciences and technology of Mechanical Engineering. This option complements our current offerings and provides potential graduate students with another opportunity which may better suit their needs, than the MS with thesis option. The non-thesis MS program involves academic course work, a research component related to coursework or, a review of research papers and concludes with a final presentation to the Examination Committee. The purpose is to ensure a research component is preserved through this MS degree program. This degree option may be more applicable for those applicants who are interested in part-time studies, who are employed and pursuing professional development, or careers in industry. Please contact megrad@vt.edu for specific location information. Acceptance into the VT Mechanical Engineering graduate program is based on the overall application package. Admission does not guarantee financial assistance. Non-thesis MS students do not qualify for departmental funding. In general, the minimum target requirements are to the left. The application materials required can be accessed from the ME Graduate Students web page. Master of Science (MS) Thesis Degree Requirements The Master of Science (MS) in Mechanical Engineering requires students to complete a minimum of 30 semester hours of technical graduate course study beyond the baccalaureate, and complete a research thesis. MS students must submit a proposed Plan of Study to the ME Graduate Coordinator & Academic Advisor before completing the first semester registered as an MS student. An official final plan of study is due by the end of the second semester. The MS in Mechanical Engineering must include the following minimum requirements: Research and Thesis (5994): 6 hours minimum (A maximum of 10 hours of 5994 is allowed. Students should register in additional research hours as ME 7994 towards the PhD and these hours should not appear on the MS plan of study.) Approved technical coursework meeting the following requirements: 20 hours minimum Courses numbered 5000, or higher: 15 hours minimum ME Coursework: 9 hours minimum ME approved Mathematics or Statistics: 3 hours post baccalaureate A maximum of two Virginia Tech 4000 level courses is allowed to meet degree requirements and must be on the ME Technical Elective List for undergraduate ME students. If it is a conjoint course, it must be taken at the 5000 level. A maximum of 6 hours of Special Study (5984 only), and a maximum of 6 hours of Independent Study (5974 only), with the total of both not to exceed 9 hours is allowed. Transfer courses meeting Graduate School policies, are listed and approved on the official Plan of Study. Official transcripts and course descriptions are required. Master of Science (nt-MS) non-thesis Degree Requirements Departmental funding is not available for the non-thesis Master of Science (nt-MS) program, as this program does not require research hours but does require more coursework (24 hours). The nt-MS (non-thesis) in Mechanical Engineering must include the following minimum requirements: Project and Report (5904): 1-6 hours Approved technical coursework meeting the following requirements: 30 hours minimum Courses numbered 5000, or higher: 18 hours minimum ME Coursework: 9 hours minimum ME approved Mathematics or Statistics: 3 hours post baccalaureate A maximum of two Virginia Tech 4000 level courses are allowed to meet degree requirements and must be on the ME Technical Elective List for undergraduate ME students. If it is a conjoint course, it must be taken at the 5000 level. A maximum of 6 hours of Special Study (5984 only), and a maximum of 6 hours of Independent Study (5974 only), with the total of both not to exceed 9 hours is allowed. Transfer courses meeting Graduate School policies, are listed and approved on the official Plan of Study. Official transcripts and course descriptions are required. The Graduate School requires a Diversity and Inclusion component for all graduate students. EngE 5304 Graduate Student Success in a Multicultural Environment meets this requirement and is listed as a supporting course on the plan of study.Seminar Program: All full-time Blacksburg students must participate in the Mechanical Engineering seminar series each semester by registering in ME 5944. These hours are not counted towards technical course requirements and are not listed on the plan of study.Ethics: All graduate students must meet the Graduate School's Ethics requirement by completing CITI Training modules on Canvas or, the supporting course, GRAD 5014 Academic Integrity & Plagiarism, within their first 2 semesters.   No courses below the 4000 level are accepted for graduate credit.   Contact the ME graduate program for approval procedures before   taking any Independent Study (5974 only) courses.   Summer registration is not required for continuing students.

Degree Concentrations:

Nuclear Engineering Graduate Certificate

A student must take a total of at least 9 credit hours with a letter grade of B or better in every course to obtain the Nuclear Engineering Graduate Certificate. Six credit hours must be from 5000-level courses or higher. More information is available in the Graduate Catalog.Required: NSEG 5114 Nuclear Engineering Fundamentals: 3 creditsElectives: Minimum 6 credit hours from the approved course list (at least 3 credithours must be at the 5000-level or higher)

GRADUATE COURSES (ME)

ME 5014:

Graduate Assistant Training for the Mechanical Engineering Professoriate

Teaching assistant in-the-laboratory training for Mechanical Engineering courses. Responsibilities of the instructor and teaching assistant in the classroom and laboratory. Leadership development and team building. Professionalism in communication and work interaction. Lab practice: scheduling, safety, development of experiments and troubleshooting. Communication in mechanical engineering: critiquing and grading. Working with a diverse group and inclusivity. Engineering ethics. Restricted to students enrolled in the Graduate Certificate: Mechanical Engineering Professoriate. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5034:

Bio-Inspired Technology

Introduction to engineering solutions inspired by the functional mechanisms of biological systems. An overview of bio-inspired technology and the state of the art. Exploration of the relationship between engineered and natural biological systems. Concepts of biological systems, such as evolutionary optimization, sensing, actuation, control, system integration, assembly, and materials in engineering terms. State-of-the art of bio-inspired technology. Interdisciplinary analysis skills are practiced in projects where man-made and biological systems are evaluated for parallels and the technological potential of the biological systems. Prerequisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5104:

Thermodynamics: Foundations and Applications

Exposition of the basic concepts and principles of thermodynamics. Principles and results developed for both macroscopic and microscopic systems as well as equilibrium and non-equilibrium states. Definition of entropy for any state. The definition of temperature; pressure, total potential; heat; work; the fundamental Gibbs, Euler, Gibbs-Duhem, and Maxwell relations; characteristic functions; and the state principle. Definition and use of thermo-physical properties, charts, tables, and equations of state for pure as well as mixtures of ideal and real gases, liquids and solids. Second Law analysis, energy conversion, chemical reactions and chemical equilibrium, and introduction to the phenomenological laws of non-equilibrium thermodynamics. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5174 (BMES 5174):

Biomechanics of Crash Injury Prevention

Principles of design and analysis of crash injury prevention methods in vehicle crashes. The course encompasses three major focus areas for occupant protection in crashes: crash energy absorption in (1) the vehicle structure, (2) the occupant, and (3) the occupant restraints. Topics include the biomechanics of impact injury, analysis of occupant response in crash tests, vehicle crash kinematics, modeling of vehicle impact response, modeling of human impact response, and occupant restraint design. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5184 (AOE 5184):

High Speed Propulsion

Analysis of high-speed air breathing propulsion concepts for hypersonic flight. Aerodynamic inlet design and flow path integration. Cycle analyses, flight performance, and design limitations given a set of design requirements. Aerothermodynamic analysis of ramjets, scramjets, and detonation wave engines. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5204 (BMES 5204):

Lab Techniques Injury Prev

Human surrogate biomechanical impact testing. 3-D rigid-body kinematics, kinetics, properties of deformable materials, servosled testing. Injury prediction and mitigation for transport systems. Transportation restraint system design. Instrumentation, data acquisition, and signal processing techniques of impact biomechanics. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5214:

Combustion

Combustion science and its applications and introduction. Thermodynamics of gaseous mixtures, chemical kinetics of gases, transport properties of gaseous mixtures, chemical reactors and chemically reacting flows. Waves in chemically reacting flows, deflagrations and deformations. Laminar premixed flames, laminar diffusion flames. Liquid fuels combustion. Pollutants formation in combustion.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5264 (ESM 5264):

Mechanics of Adhesive Bonding and Interfaces

Principles of mechanics applied to adhesively bonded joints and interfaces, overview of adhesion technology, stress analysis of adhesive joints, stresses in bimaterial systems and interfaces, failure mechanisms and fracture, thermodynamic and observed toughnesses, time dependence and durability, design.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5304:

Conduction and Radiation Heat Transfer

Principles of conduction. Analysis of one-dimensional and multidimensional steady and transient, phase change and moving heat source problems are examined. A comprehensive treatment of numerical and analytical methods for solving heat conduction problems is presented.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5314:

Convective Heat and Mass Transfer

Principles of convection. Analysis of heat transfer for internal and external flows; laminar and turbulent boundary layer theories; forced and natural convection. Analysis using similarity transformations, integral solutions and numerical methods.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5324:

Radiation Heat Transfer

Introduction to thermal radiation; the electromagnetic spectrum; the blackbody; wave phenomena versus geometric optics; polarization, diffraction, and refraction effects; emission, reflection, absorption, and transmission of thermal radiation by surfaces; radiant interchange among surfaces; radiation through a participating medium; the Monte Carlo raytrace method; uncertainty and confidence interval of results. Knowledge of thermodynamics at the undergraduate level is recommended.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5344G:

Advanced Biological Transport Phenomena

Engineering analysis and predictive modeling of heat and mass transport in biological systems (e.g., tissues, organs, organisms, and biomedical devices). Examination of processes that involve conduction, convection, diffusion, generation/ consumption. Application of analytical and computational methods to solve differential equations that describe unsteady and/or multi-dimensional transport. Topics include oxygen transport, drug delivery, pharmacokinetic analysis, kidney function, blood perfusion, cryopreservation, and hyperthermia. Pre: Graduate standing.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5404:

Fluid Dynamics

Fundamental fluid mechanics: kinematics and dynamics. Continuum fluid dynamics including hydrostatics, flow kinematics, the concept of stress, constitutive relations, the equations of motion and energy for compressible and incompressible viscous and inviscid flows. Incompressible Newtonian viscous flows, similitude and physical modeling, inviscid potential flows, inviscid flows with vorticity, boundary layers, and an introduction to turbulent flow. I.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ME 3404
Corequisite(s):

ME 5414:

Nonlinear Systems

Dynamics of conservative and nonconservative systems; phase planes; local and global stability; damping mechanisms; self-excited oscillators. Forced oscillations of one-degree-of-freedom systems; primary, secondary, and multiple resonances; period-multiplying bifurcations; strange attractors; chaos. Parametric excitations; Floquet theory; influence of damping and nonlinearity. Multi-degree-of-freedom systems; concepts of internal and external resonances; Hopf bifurcation. Applications to continuous systems; strings, beams, plates, and shells.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5754, ESM 5304

Corequisite(s):

ME 5424:

Turbomachinery

Application of fluid mechanics and thermodynamics to turbomachinery, with emphasis on high speed machines. Review of basic concepts and ideal performance. Viscous effects - losses and stall. Three dimensional and secondary flow. Actual machine performance and design considerations. Selected topics including axial and centrifugal machines, transonic flow, transient behavior, and three-dimensional flow design. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5434 (AOE 5434G):

Advanced Introduction to Computational Fluid Dynamics

Euler and Navier-Strokes equations governing the flow of gases and liquids. Mathematical character of partial differential equations. Discretization approaches with a focus on the finite difference method. Explicit and implicit solution techniques and their numerical stability. Introduction to verification, validation, and uncertainty quantification for computational fluid dynamics predictions. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5444:

Interfacial Fluid Mechanics

Interfacial fluid systems involving surface tension, interfacial hydrodynamics, and phase-change heat transfer. Scaling analysis and non-dimensionalization will be used to mode a variety of interfacial phenomena relevant to fluid mechanics and phase-change heat transfer. Capillarity, surface wettability, hydrodynamics of interfaces, flow instabilities, long range forces, convective and diffusive boundary layers, homogeneous and heterogeneous nucleation, and multiphase flows. Pre: Graduating standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5454:

Interfacial Thermodynamics and Transport

Intermolecular forces (covalent, van der Waals, and Coulombic forces) and their thermodynamic considerations. Molecular structure and thermodynamic properties of liquid-solid, liquid-vapor, and liquid-liquid interfaces. Thin films and wetting. Disjoining pressure (van der Waals, double layer, and solvation forces; non-classical forces). Transport phenomena driven by interfacial forces, including electrokinetic transport, diffusioosmosis, and diffusiophoresis. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5514:

Vibrations of Mechanical Systems

Single degree-of-freedom systems, multiple-degree-of- freedom system and distributed parameter systems ending in dynamic finite element modeling. Numerical solutions, isolation, absorption, optimal design for vibration reduction, analytical modal methods, transfer function methods. Damping models and analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 3504

Corequisite(s):

ME 5524:

Bayesian Robotics

Principles of autonomous robotics control for unstructured environments. Probability theory, numerical techniques for recursive Bayesian estimation and multi-sensor data fusion, simultaneous localization and mapping, quantification of belief, Bayesian control. Prerequisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5544 (AOE 5744) (ECE 5744):

Linear Systems Theory

Advanced introduction to the theory of time-varying and time-invariant linear systems represented by state equations; solutions of linear systems, uniform stability and other stability criteria, uniform observability and controllability, state feedback and observers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 (UG) OR ECE 4405 OR ECE 4624 (UG) OR ECE 4624 OR ECE 4634 (UG) OR ECE 4634 OR ME 4504 (UG) OR ME 4504 OR AOE 4004 (UG) OR AOE 4004

Corequisite(s):

ME 5554 (AOE 5754) (ECE 5754):

Applied Linear Systems

Develop an applied understanding of state-space representations for linear time invariant multi-input multi-output dynamic systems in both time domain and frequency domain. Introduction to modern state-space control methods; state feedback and output feedback. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 OR ECE 4624 OR ECE 4634 OR ME 4504 OR AOE 4004 OR ECE 4405 (UG) OR ECE 4624 (UG) OR ECE 4634 (UG) OR ME 4504 (UG) OR AOE 4004 (UG)

Corequisite(s):

ME 5564 (ECE 5764) (AOE 5764):

Applied Linear Control

Analysis and design of sampled-data systems, extraction of discrete-time dynamic models from experimental data, and implementation of dynamic compensators on digital processors. In-depth design experience with LQR optimal control and an introduction to Kalman filtering. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 5554 OR ME 5544 OR AOE 5744 OR AOE 5754 OR ECE 5744 OR ECE 5754

Corequisite(s):

ME 5574 (AOE 5774) (ECE 5774):

Nonlinear Systems Theory

Introduction to the theory of systems of coupled, nonlinear, time-varying ordinary differential equations: existence and uniqueness of solutions; continuous dependence on parameters; stability of equilibria and stability analysis techniques; input-to-state stability; input-output stability; nonlinear design techniques including input-state and input-output feedback linearization, backstepping, and sliding mode control. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5584 (ECE 5734) (AOE 5734):

Convex Optimization

Recognizing and solving convex optimization problems. Convex sets, functions and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5634:

Finite Elements in Machine Design

Advanced analysis and design of machine components with emphasis on the finite element method of analysis using commercial software. Structural and continuum elements will be used for both the static and dynamic analysis and design of machine components. Practice oriented analysis techniques and design procedures employable through the finite element method will be developed. Design problems will constitute a significant part of the course. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 3614

Corequisite(s):

ME 5644:

Rapid Prototyping

Participants will study topics fundamental to rapid prototyping and automated fabrication, including the generation of suitable CAD models, current rapid prototyping fabrication technologies, their underlying material science, the use of secondary processing, and the impact of these technologies on society. The rapid prototyping process will be illustrated by the actual design and fabrication of a part. Partially duplicates ME 4644; credit may only be received for one course. Co: ME 4634 or equivalent background; programming skills.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5654:

Multibody Systems Dynamics

Dynamic systems with planar and spatial rigid multibody models. Position and orientation of bodies in space. Holonomic and nonholonomic constraints. Planar and spatial joints. Derive driving constraints. Characterize the manifold using differential geometry. Singular configurations. Kinematics analysis. Equations of motion. Calculate the centroid, moments, and products of inertia. Formulate internal generalized forces. Multibody system dynamics in the ordinary differential equations (ODE) and differential algebraic equations (DAE) formulations. Tangent space ODE and tangent space index 0 formulations for holonomic systems; implement and solve the kinematic and dynamics of rigid multibody systems using numerical methods. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5664:

Global Collaborative Product Development

Participants will study topics fundamental to global collaborative product development, project data management, and collaborative product data management. These topics will be applied during a team project with team members located overseas, utilizing state-of-the-art collaborative engineering and product data management software and hardware technologies. Partially duplicates 4664; credit may only be received for one course. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ME 2024 (UG) OR ME 2024), (ME 4634 (UG) OR ME 4634)

Corequisite(s):

ME 5674:

Tire Mechanics

Introduction to tire mechanics with emphasis on tire modeling for vehicle dynamic simulation. Tire mechanics explained from several view points: engineering mechanics, system dynamics, and empirical procedures. Vehicle dynamic modeling including suspension and steering systems covered providing details on the effect of tire dynamics on vehicle behavior. Real tire data provided to be used for vehicle dynamics simulation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5694:

Advanced Design Project

Teams solve complex engineering problems, typically originating for industry, with emphasis on new product development, using the engineering design process. Emphasis on project management, engineering economics, and professional skills in presentation of a proposed business plan and technical solution. Intended for students in the Virginia Tech - Technische Universitat Darmstadt dual Master of

Science in Mechanical Engineering degree program. May be repeated for a maximum of 6 credits, but then in different fields of mechanical engineering. Variable credit of 1-6 hours

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ISE 5174

Corequisite(s):

ME 5704 (ECE 5704):

Robotics and Automation

Automation, mechatronics, robot technology, kinematics, dynamics, trajectory planning, and control of two-dimensional and spatial robots; robot programming; design and simulation of robotic devices. Laboratories associated with robot forward/inverse kinematics, task planning, velocity kinematics, force rendering, control, haptics, mobile robotics, mapping/localization, computer vision and path planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5714 (BMES 5514):

Digital Signal Processing for Mechanical Measurements

The fundamentals of digital signal processing of data experimentally obtained from mechanical systems will be covered. Attention will be given to the data acquisition, A/D conversion, aliasing, anti-aliasing filtering, sampling rates, valid frequency ranges, windowing functions, leakage, and various transform methods. Special attention will be given to random, transient, and harmonic function data processing. Various methods of estimation of the frequency response function (FRF) will be explored. The estimation methods will be assessed as to their impact on FRF estimation errors. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 3504, ME 4504

Corequisite(s):

ME 5724:

Advanced Instrumentaion and Signal Processing

Advanced techniques in instrumentation using state-of-the- art transducers, techniques in data acquisition and signal processing. Techniques for estimating errors and optimizing data quality.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 4005

Corequisite(s):

ME 5734:

Advanced Engineering Acoustics

The fundamental principles underlying the generation, transmission, and reception of acoustic waves will be presented. Methods for analytically investigating various acoustic and structural acoustic situations encountered in practice will be developed. The application of these methods to typical engineering acoustical problems with physical interpretation of the results will be demonstrated.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 4724

Corequisite(s):

ME 5735G:

Advanced Mechatronics

Electromechanical design and control applications. Design and building of electronic interfaces and controllers for mechanical devices, sensors, signal acquisition, filtering, and conditioning. Microcontroller-based closed-loop control and device communications. Sensor and actuator selection, installation, and application strategies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5736G:

Advanced Mechatronics

Electromechanical design and control applications. Design and building of electronic interfaces and controllers for mechanical devices, sensors, signal acquisition, filtering, and conditioning. Microcontroller-based closed-loop control and device communications. Sensor and actuator selection, installation, and application strategies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ME 5735G
Corequisite(s):

ME 5744:

Methods of Mechanical Engineering Analysis

Introduction to selected mathematical techniques oriented toward solving advanced continuous and lumped parameter problems of the type often encountered in mechanical engineering. Elliptic, parabolic and hyperbolic ordinary and partial differential equations are discussed. Solution by separation of variables, integral transforms, Greens functions and numerical methods. The emphasis is on understanding how physical processes work.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5764 (BMES 5764):

Modeling MEMS and NEMS

Modeling MEMS and NEMS is about the construction, analysis, and interpretation of mathematical and computational models of microelectromechanical and nanoelectromechanical systems (MEMS and NEMS). A goal throughout the course will be to develop a physical intuition for the fundamental phenomena at these small scales. The material covered will be broad and multidisciplinary including: dimensional analysis and scaling; a review of continuum mechanics; fluid dynamics, elasticity, thermal transport, and electromagnetism at the micro and nanoscales; the modeling of a variety of new MEMS/NEMS devices; and approaches beyond the continuum theory including stochastic and deterministic methods. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5784:

Advanced Industrial Internet of Things Platform

Theory and applications of Industrial Internet of Things (IIoT). Industrial data flow, devices and network. Basics for IIoT architecture and Cloud computing platforms. Hands-on experience with Cloud computing platforms and original equipment manufacturer (OEM) IIoT platforms. Practical projects to demonstrate device connection, data transfer and apply diagnostics, maintenance, and predictive data analytics on IIoT platforms. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5794:

Optimization Techniques in Engineering

Fundamental mathematical concepts for optimization and optimality conditions. Classification of optimization techniques/problems in engineering. Concepts of forward and inverse design. Linear programming, 1st and 2nd order gradient-based algorithms. Evolutionary strategies for optimization. Sensitivity analysis. Reliability-based and robustness-based optimization. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 5804:

Active Material Systems and Smart Structures - I

Behavior and physics associated with ceramic and polymeric active materials; constitutive models of piezoelectric and electrostrictive ceramics and polymers derived from thermodynamic relationships; development of static and dynamic models of systems that incorporate active materials derived using variational mechanics. Piezoelectric and electrostrictive ceramics and polymers, ionomeric polymers, conductive polymers, and carbon nanotubes will be studied. Applied topics in structural health monitoring, motion control, vibration control, and sensing will be studied.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ME 3514, ME 3504 OR ME 4504
Corequisite(s):

ME 5814:

Energy Harvesting

Criterion of harvesting, identification of energy sources, theory of vibrations, PSD, measurement and analysis. Selection of materials for energy conversion, piezoelectric, electromagnetic, electrostrictive, magnetostrictive, magnetoelectric, dielectric elasomers, conducting polymers, metal-ceramic composites, electrets, electostatic, thermoelectric, photovoltaic. Design and characterization, modeling and fabrication of vibration, wind, thermal gradient, and light energy harvesters; resonance phenomenon, equivalent circuits and storage. Case studies for applications of industrial systems, surveillance, automobliles and the human body. Prerequisite: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5824 (CS 5844):

Algorithmic Human-Robot Interaction

Formalizing interaction between robots and humans. Developing learning and control algorithms that enable robots to seamlessly and intelligently collaborate with humans. Mathematical approaches to human-robot interaction, learning from demonstration, Bayesian inference, intent detection, safe and optimal control, assistive autonomy, and user study design. Students review and present existing literature, conduct a research project. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5854G:

Advanced Nano and Micromechanics of Materials

Analysis of microstructural mechanics, crystal structures, defects, and dislocations. Mechanical behavior of crystalline materials at the microscale. Computational modeling of mechanical behavior in discrete atomistic and molecular systems, including molecular dynamics. Application of these methods to polymers and other soft materials, biological materials, carbon-based materials, and metallic alloys. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5864G:

Advanced Micro/Nano-Robotics

Overview of micro/nano-robotic systems, physics of reduced length scales (scaling effects in the physical parameters, surface forces, contact mechanics, and micro/nano-scale dynamical phenomena), basics of micro/nano manufacturing, microfabrication and soft lithography, biomimetic design strategies for mobile micro-robots, principle of transduction, material properties and characteristics of micro/nano-actuators (piezoelectric, shape memory alloy, and a variety of MEMS and polymer actuators), control requirements and challenges of micro/nano-actuators, micro/nano sensors for mobile microrobotic applications, micro/nano-manipulation (scanning probe microscopy, operation principles, designing experiments for nanoscale mechanical characterization of desired samples). Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5874:

Experimental Robotics

Robot Operating System (ROS) installation and operation, Linux, MATLAB and TCP communication with ROS, Integration of sensor, actuator, microcontroller and onboard computer, Object recognition, Simultaneous localization and mapping, Bayesian control. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ME 5924:

Vibration of Continuous Systems

An introduction to basic and advanced methods of solving vibration problems associated with continuous systems using Newton's law, D'Alembert's principle, Hamilton's principle, and Lagrange's equations. Derivation of equations of motion and associated boundary conditions for transverse and longitudinal vibration of bars, torsional vibration of circular shafts, transverse vibration of beams, and transverse vibration of membranes using the formulation of boundary value problems (Newtonian and Lagrangian). Introduction to exact solutions (free vibration and differential eigenvalue problem, forced vibration) and approximate methods (RayleighRitz method, assumedmodes method). Introduction to experimental modal analysis. Knowledge of discrete vibrating systems at an advanced undergraduate level is recommended. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5944:

ME Graduate Seminar

This course will consist of a series of 50-minute lectures given by invited guests from industry, government organizations, and other universities as well as ME Ph.D students. May be repeated for a maximum of 6 credits. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

ME 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

ME 6014:

Mechanical Engineering Professoriate Preparation Seminar

Training for doctoral students mechanical and nuclear engineering preparing for an academic career. Course development and enhancement. Pedagogy and teaching preparation. Student recruitment, advising, mentoring, and retention issues. Marketing and networking. Research initiation, funding, and productivity metrics. Research teams and collaboration. Publications and intellectual property. Ethical behavior. Academic career planning and promotion and tenure. Restricted to students enrolled in the Graduate Certificate: Mechanical Engineering Professorate. Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 6104:

Advanced Topics in Thermodynamics

Exposition of the basic concepts and principles of statistical thermodynamics including statistical mechanics, probability theory, quantum mechanics, kinetic theory, and thermo-physical and transport properties. Presentation of the basic concepts and principles of gas dynamics for compressible flow within normal temperature ranges (i.e. excluding the very high temperatures at which plasmas form). A more in depth look at chemical thermodynamics including chemical equilibrium and chemical kinetics. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 5104

Corequisite(s):

ME 6434 (AOE 6434):

Computational Fluid Dynamics and Heat Transfer

Overview of numerical methods used in the study of computational fluid dynamics (CFD) and heat transfer. Spatio-temporal finite-difference, finite-volume discretizations, solution of linear systems with direct and iterative methods, algorithms for solving the Navier Stokes and energy equations, and turbulence modeling. Applications to inviscid subsonic, transonic, and supersonic flows and viscous boundary layer. Theory reinforced with hands on programming assignments and the application of commercial CFD packages to select problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 5404, ME 5314, ME 5104

Corequisite(s):

ME 6444 (CS 6444) (AOE 6444):

Verification and Validation in Scientific Computing

Applicable to scientific and engineering models described by partial differential or integral equations. Software engineering, code verification, and the method of manufactured solutions for generating exact solutions. Estimation of numerical approximation errors in scientific computing. Design and execution of experiments for model validation and model accuracy assessment. Propagation of aleatory and epistemic uncertainty through models. Estimation of total prediction uncertainty in scientific computing simulations. Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

ME 6504:

Nonlinear Vibrations and Applications

Stability, floquet theory, and bifurcation; phase-plane; asymptotic and perturbation methods; internal, primary, secondary, and parametric resonances; singular point, limit cycles, and chaos; cables and beams; piezoelectric and electromagnetic based nonlinear energy harvesting; nonlinear vibration absorbers and energy sink; friction-induced oscillations; wind-induced vibrations; microelectro mechanical systems (MEMS) sensors/actuators; and wave propagation, nonlinear metamaterials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 5514

Corequisite(s):

ME 6544 (AOE 6744) (ECE 6744):

Linear Control Theory

Advanced introduction to the theory of optimal control of time-varying and time-invariant linear systems; Solutions to the linear-quadratic regulator, optimal filtering, and linear-quadratic-gaussian problems; Robustness analysis and techniques to enhance robustness of controllers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5744 OR ECE 5754 OR ME 5544 OR ME 5554 OR AOE 5744 OR AOE 5754

Corequisite(s):

ME 6574 (ECE 6774) (ISE 6574) (AOE 6774):

Adaptive Control Systems

Introduction to the theory and methodology used to design adaptive controllers for uncertain systems, addressing issue such as input constraints, disturbance rejection, partial measurements, and robustness.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)

Corequisite(s):

ME 6744:

Chaos & Nonlinear Dynamics

Overview of theoretical and numerical approaches for the study of nonlinear and chaotic dynamics in science and engineering. Fractals, bifurcation analysis, predictability, strange attractors, and routes to chaos. Roles of dissipation and noise in deterministic chaos. Use of Lyapunov spectra, fractal dimension, information, entropy, correlation functions, and attractor reconstruction to describe chaos. Chaos in iterated maps and systems of nonlinear ordinary differential equations. Spatiotemporal chaos in coupled map-lattices and in systems of nonlinear partial differential equations. Numerical integration of systems of stiff equations, operator splitting, exponential time integration, spectral and pseudo-spectral methods.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ME 5404, ME 5744
Corequisite(s):

ME 6804:
Feedback Control of Dynamic Legged Locomotion
Modeling and control methodologies for bio-inspired robots (bipedal and quadrupedal robots), dynamic stability and robustness of gaits, nonlinear controller techniques for agile locomotion, optimization-based techniques for gait planning and numerical simulation of legged machines.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ME 5574
Corequisite(s):

ME 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ME 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

MINING ENGINEERING

Kramer Luxbacher, Head

Emeriti Faculty: Michael Karmis;
Professors: Erik Westman; Roe Yoon;
Associate Professors: Mario Karfakis; Christopher Noble; Nino Ripepi; Emily Sarver;
Assistant Professors: Bahareh Nojabaei; Rohit Pandey; Wencai Zhang;
Stonie Barker Professor: Emily Sarver;
University Distinguished Professor and Nicholas T. Camicia Professor: Roe Yoon;

Graduate Contact: mcrotto@vt.edu
Graduate Contact: esarver@vt.edu
Department Website: http://www.mining.vt.edu/
Graduate Site: http://www.mining.vt.edu/Graduate/grad_home.html

The Department of Mining and Minerals Engineering (MME) offers advanced graduate degrees (MEng, MS and PhD) that are designed to educate students for high-level challenges in industry, academia, and government. Graduate work may be pursued in several areas of specialization including rock mechanics, ground control, health and safety systems, critical mineral processing, applied surface and colloid chemistry, recycling, conservation and the environment, mining ventilation, modeling/simulation, automation and control, carbon sequestration and management, and reservoir engineering. One or more of the topics may be emphasized within the department at a given time based on the ongoing research activity of the full-time faculty assigned to the department. Graduate students accepted to the program are generally provided financial support through sponsored grants, teaching assistantships or graduate fellowships. A major goal of the department is to afford all graduate students with the opportunity to participate in creative and challenging research projects, which typically lead to scholarly publications in international journals and conference proceedings. The graduate program also recognizes the specific needs of industry professionals with a program that strives to upgrade technological skills of practicing engineers, encourage the pursuit of doctoral-level work, and provide an opportunity for advanced education and career reorientation. The MME graduate program is administered by the Graduate Director and a Departmental Graduate Committee. The Departmental Graduate Committee is responsible for identifying high-quality students acceptable for admission, for overseeing the graduate program curriculum, and for establishing and monitoring program standards. The Department Head appoints faculty members to serve on the Departmental Graduate Committee and approves all petitions to the Graduate School based upon the recommendations of the committee.

SPECIAL FACILITIES
The Department of Mining and Minerals Engineering at Virginia Tech offers graduate students access to state-of-the-art equipment and world-class facilities for research studies. The facilities include laboratories for advanced computing, mine automation and control, carbon storage, environmental monitoring, geomechanics, health and safety, mineral processing, mine rescue, rock mechanics, subsurface atmospheres, surface and colloids, mine surveying and mine ventilation.The laboratories are supported by a well-equipped mechanical shop.

Department Facilities
The following is a listing of laboratories currently operated and maintained by the department. Advanced Computing Laboratory: In addition to the university's state-of-the-art supercomputer systems, the department operates a dedicated computing facility equipped with modern workstations and large-scale printers/plotters. Additionally, the

department houses a dedicated supercomputer utilized for CFD and advanced reservoir modeling. Mine Automation and Process Control Laboratory: The facilities in the Mine Automation and Process Control Laboratory include 10 workstations equipped with state-of-the-art industrial programmable logical controllers (PLCs) and associated input/output and communication modules. The workstations provide hands-on experience in hardware configuration, software development, input/output wiring, ladder logic programming, analog-digital conversion, loop control and tuning, communication architectures, human interfaces and troubleshooting. Carbon Storage/Management Laboratory: This laboratory is home to specialized equipment and instrumentation used in cutting-edge research programs related to the production of coalbed methane and natural/shale gas and the geologic sequestration of carbon. The facility includes equipment and instrumentation for capacity assessment and field validation of geologic reservoirs and formations. Environmental Laboratories: The environmental laboratory facilities include instrumentation for routine water/soil analysis and dust monitoring. A new thermogravimetric analyzer and microbalance have recently been installed to allow analysis of organic compounds in dusts and other solid samples. The laboratory is also equipped with a diesel engine and particle size analyzers for investigation of diesel particulate matter. Detailed characterization of both solid and water samples is conducted through cooperation with other laboratories on campus. Geomechanics Instrumentation Laboratory: The facilities in the Earth Systems Instrumentation Laboratory include a 16-source, 18-receiver ultrasonic tomography system. This system includes a Panametrics ultrasonic pulser, a 16-channel switchbox, PAC Micro-80 piezoelectric transducers, and National Instruments PXI-6115 high-speed digitizers (20 Msamples/sec). Additional equipment includes a 16-channel acoustic emission monitoring system which is used for laboratory passive tomography. Mineral Processing Laboratories: The facilities in mineral processing include a wide array of laboratory equipment for crushing, grinding, separation, dewatering and drying. In addition, the department operates a modern pilot-plant facility that is home to process units such as ball mills, flotation banks, flotation columns, conditioners, electrostatic/magnetic separators, vacuum filters, ore bins, conveyors, sumps and pumps. Supporting equipment includes a vast array of advanced instruments for particle size analysis, mineralogical characterization and elemental determinations. Mine Rescue Laboratory: The Mine Rescue Laboratory houses eight Biomarine mine rescue apparatus and associated support equipment, including standard communication, rescue and first aid equipment, as well as personal protective equipment. Rock Mechanics and Ground Control Laboratory: The rock mechanics facilities include a laboratory for preparation of rock specimens for strength testing, three megapound testing machines (three MTS servo-controlled, stiff-test units with computerized data acquisition facilities, one of which is for dynamic testing at 2 m/sec loading rate), triaxial and two shear testing units, a creep testing machine with digital data acquisition system, equipment for seismic testing of rock in both field and laboratory, and subsidence monitoring equipment. Shale/Natural Gas Laboratory: The shale/natural gas laboratory is home to a variety of instrumentation and equipment used in the study of shale/natural gas resources. This laboratory is used by faculty engaged in the study of gas transport processes through nanometer-scale pore geometries. Ongoing studies include rock characterization, image processing, and pore-scale simulation. Subsurface Atmospheres Laboratory: The Subsurface Atmospheres Laboratory houses 3 gas chromatographs and 1 gas chromatograph with mass spectrometer. The laboratory is utilized for characterization of subsurface atmospheres and systems including underground mine ventilation systems, as well as shale and coal reservoirs. Detectors include flame ionization, thermal conductivity, and electron capture. The facility also has autosampling capability and utilizes associated technologies including two digital mass flow controllers, sample vacuum system, and solid phase microextraction. Surface and Colloid Chemistry Laboratories: Some of the noteworthy facilities of the surface and colloid chemistry laboratories include a UV spectrophotometer, AA spectrometer, FTIR spectrophotometer, isothermal/isoperibol microcalorimeter, flow microcalorimeter, potentiostats, turbidimeter, surface tensiometers, electrophoresis apparatus, ellipsometers, surface force analyzer, atomic force microscope, and Langmuir trough. Mine Surveying Laboratory: The Mine Surveying Laboratory houses nine total stations, six levels, and associated equipment including tapes, tripods, reflector prisms and rods. Mine Ventilation Laboratory: The facilities in the mine ventilation laboratory include three scaled wind tunnels, fans and various equipment for ventilation air monitoring including analog and digital manometers, methane detectors and anemometers. An additional tunnel is fully instrumented with fan control by PLC and injection and sampling ports for tracer gas experiments.

Research Centers

The Department of Mining and Minerals Engineering is home to two acclaimed research centers: the Virginia Center for Coal and Energy Research (VCCER) and the Center for Advanced Separation Technologies (CAST). The centers offer students access to cutting-edge facilities and equipment in these specific focus areas. Center for Advanced Separation Technologies (CAST) - CAST is a consortium of five universities whose goal is to develop advanced technologies that can be used to produce clean solid, liquid and gaseous fuels from domestic energy resources in an efficient and environmentally acceptable manner. Current member institutions are Virginia Tech, West Virginia University, University of Kentucky, University of Utah and Montana Tech. CAST has funded more than 100 projects at seven universities. More information about this center can be obtained at www.cast.mining.vt.edu. Virginia Center for Coal and Energy Research

(VCCER) - VCCER serves as an interdisciplinary study, research, information and resource facility for the Commonwealth of Virginia. VCCER involves five primary functions: (i) Research in interdisciplinary energy and coal-related issues of interest to the Commonwealth, (ii) Coordination of coal and energy research at Virginia Tech, (iii) Dissemination of coal and energy research information and data to users in the Commonwealth, (iv) examination of socio-economic implications related to energy and coal development and associated environmental impacts, and (v) assist Commonwealth of Virginia in implementing the Commonwealth's energy plan. The center has offices in the main Virginia Tech campus in Blacksburg and the Southwest Virginia Higher Education Center in Abingdon. More information about this center can be obtained at www.energy.vt.edu.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative

Master of Science (MS): Successful MS students must complete 30 hours of university credit of which a minimum of 20 hours involve coursework and a maximum of 10 hours involve research. Students must also prepare and defend a written Thesis of their research findings during a Final Examination before an Examining Committee.

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative

Master of Engineering (MEng): Successful MEng students must complete 30 hours of applicable coursework and prepare and defend a written Project Report during a Final Examination before an Examining Committee.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative

Doctor of Philosophy (PhD): Successful PhD students must complete 90 hours of university credit of which a minimum of 30 hours involve coursework and a maximum of 60 hours involve research. Students must also prepare and defend a written Dissertation of their research findings during a Final Examination before an Examining Committee. PhD candidates must pass a Qualifying Examination prior to the end of their first year of residency and must also pass a Preliminary Examination at least six months prior to taking the Final Examination.

GRADUATE COURSES (MINE)

MINE 5025:

Advanced Mining Design

Selected advanced design problems in mining including roof control, shafts, material handling, transportation, drainage, and ventilation. Advanced work in creative quantitative design or ore milling and coal preparation plants.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5045:

Advanced Mineral Processing

The theory of reactions in flotation systems and application of physical chemistry to mineral beneficiation. Advanced studies in electrostatic and magnetic separation. Theory and application of differential gravity separations. Advanced studies in comminution, grinding systems, and coal preparation plant design, simulation, and control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5084:

Stability of Rock Slopes

Factors affecting the stability and stabilization of rock slopes, geological site studies, mechanical properties of joints, calculations, influence of ground water, geometry, seismic effects, and case histories.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): , GEOS 4414

Corequisite(s):

MINE 5094:

Particulate Process Modeling

Statistical and mechanistic approaches to modeling of mineral processing and other particulate systems. Population balance modeling of particulate systems. Representation of particle distributions. Numerical simulation techniques using the digital computer. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5114:

Sustainable Development of Mineral and Energy Resources

Sustainable development in the context of mineral and energy resource extraction, including evolution and current status of principles, challenges, and best practices relative to various industry sectors and global regions; criteria for compatible engineering designs; and management strategies for stakeholder engagement and social license to operate. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5204:

Reservoir Geomechanics

Assessment and production phase of oil and gas reservoir development; tectonic stress field; prediction of pore pressure; estimation of hydrocarbon heights and fault seal potential; determination of optimally stable well trajectories; changes in reservoir performance during depletion; effects of in situ stresses in petroleum reservoirs; and the applications to wellbore stability, critically stressed faults and fluid flow, and production induced faulting and subsidence. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5205:

Coalbed Methane Reservoir Engineering

Reservoir engineering specific to coal beds for extraction of methane, including theory of gas flow in porous media, geomechanical effects of reservoir depressurization, reservoir simulation and production forecasting, drilling methods and patterns, and interactions with underground mine workings. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5214:

Multicomponent Thermodynamics

Phase behavior of petroleum fluids; saturation pressure calculations; fluid phase equilibria; first and second law of thermodynamics for open systems; two-phase fluid properties; production engineering and separator calculation; and the applications to gas injection enhanced oil recovery and carbon dioxide sequestration in petroleum reservoirs. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5224:

Flow and Transport in Petroleum Reservoirs

Basic principles of fluid dynamics; mass balance and Navier-Stokes equations; compressible flows; analytical solution of pressure diffusivity equations in petroleum reservoirs; Fourier analysis; fluid-solid interactions in proppant-supported hydraulic fractures; and the applications to petroleum production and geologic carbon sequestration. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5234:

Numerical Modeling of Petroleum Reservoirs

Introduction to oil and gas reservoirs; basic Darcy-scale fluid mechanics in petroleum reservoirs; numerical solution of partial differential equations on the basis of finite difference methods; 1D, 2D, and 3D single-/two-phase flow simulations; transient and boundary-value problems; global challenges associated with energy and water; and the applications to water flooding and hydrocarbon production in petroleum reservoirs. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5244:

Geophysical Investigation in Geoenergy Engineering

Basic principles on the acquisition and analysis of geophysical investigation data. Seismology for oil/gas exploration. Hydraulic fracture treatment monitoring. Underground mining and ground control monitoring. Carbon sequestration. Exploration of the use of common geophysical technologies and methods for characterization and monitoring activities associated with development and management of energy resources, primarily through examination of case studies and special topics related to remote sensing, ground-penetrating radar, electromagnetic sensing, well log analysis, and distributed sensing. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5324:

Particulate Process Engineering

Advanced studies in process engineering as applied to particulate separation techniques in mineral processing and coal preparation. Collection, reconciliation, and interpretation of plant performance data. Process modeling as it relates to analysis and optimization of unit operations. Elements of process design including circuit analysis and flowsheet calculations. Focus on industrial problems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MINE 5944:

Seminar

Two written or oral presentations to be made by all graduate students on their thesis topics; also participation in all other graduate student, visiting lecturer, and faculty member presentations during their scholastic tenure. Required of all students for graduation. All graduate students in the department are required to enroll in the seminar for two semesters and to attend all the seminars.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

MINE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

MINE 6034:

Chemistry of Flotation

Surface and colloid chemistry as applied to the technology of froth flotation; surface energetics, thermodynamics of adsorption, electrification of interfaces, chemistry of surfactants, oxidation and reduction of sulfide minerals, electrochemistry of sulfide flotation systems, and hydrodynamics of bubble-particle adhesion.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

MINE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MOLECULAR AND CELLULAR BIOLOGY

Professors: Daniela Cimini; Mark Cline; Carla Finkielstein; Michael Fox; Elizabeth Gilbert; Kylene Kehn-Hall; Maria Lazar; Liwu Li; David Popham; Birgit Scharf; Eva Schmelz; Igor Sharakhov; Brenda Winkel; Hehuang Xie; Zhaomin Yang;

Associate Professors: Irving Allen; Andrea Bertke; Daniel Capelluto; Clayton Caswell; Sarah Clinton; Alan Ealy; Deborah Good; Silke Hauf; Jia-Qiang He; Timothy Jarome; Shihoko Kojima; Stephen Melville; Michelle Olsen; James Smyth; Michelle Theus;

Assistant Professors: Frank Aylward; Fernando Biase; Matthew Buczynski; Susan Campbell; Daniel Cortes Estrada; Blaise Costa; Siobhan Craige; Joshua Drake; Nisha Duggal; Daniel English; Shannon Farris; Rajshekhar Gaji; Erin Gloag; Ann Gregus; Aaron Gross; Georgia Hodes; William Howe; Bryan Hsu; Brandon Jutras; Hanh Lam; Lina Ni; Alicia Pickrell; So Ra Shin; Christopher Thompson; James Weger; Jia-Ray Yu;

General Contact: mcb-program@vt.edu

Graduate Site: mcb.vt.edu

The MCB program at Virginia Tech is an interdisciplinary program in Molecular and Cellular Biology. Composed of faculty from six departments across the Virginia Tech campus and the Fralin Biomedical Research Institute, incoming students may choose research projects from four broad categories: Cell Signaling and Cancer Faculty members in Cell Signaling and Cancer study how cells sense and transduce signals, replicate, divide, differentiate, and adapt their functioning to the outside world. Techniques in this area include high-end microscopy, transcriptomics, proteomics, genetic tools, as well as structural and molecular biology. Inflammation and Immunity Research in Inflammation and Immunity covers the physiology and pathology of innate and adaptive immunity, and uses innovative technologies to study the interaction between immune cells and pathogens. Microbiology and Virology Groups in the Microbiology and Virology track investigate microbe-host and microbe-environment interactions. This includes symbiotic and pathogenic interactions, antibiotic/antiviral resistance, microbe evolution, inflammatory diseases, and pathogen-induced cancer. Neurobiology Laboratories associated with the Neurobiology track investigate the genetic, molecular, and cellular mechanisms that underpin how the brain and body grow, sense the world around them, and ultimately create behavior. Current research is focused on cellular and molecular mechanisms related to drug addiction, mood disorders, neuroendocrinology, neuroimmunology, brain development, sexual differentiation, and language production. Faculty members use a wide range of cellular and organismal models, and employ innovative techniques including advanced genomics and proteomics, fluorescence microscopy, electrophysiology, biochemistry, molecular genetics and behavioral assays. Faculty members are committed to excellent, student-oriented mentoring in all aspects of research and professional development.Colleges and Departments College of Science Biological Sciences School of Neuroscience College of Veterinary Medicine Biomedical Sciences and Pathobiology College of Agriculture and Life Sciences Biochemistry Human Nutrition, Foods, and Exercise Animal and Poultry Sciences For more information visit our website: mcb.vt.eduContact information: mcb-program@vt.edu (540)-231-7318

SPECIAL FACILITIES

The Molecular and Cellular Biology Program at Virginia Tech is an interdisciplinary graduate program that draws faculty and graduate students from three colleges on campus. Research groups are distributed over several buildings on campus. The main office is located in Life Sciences 1.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

This is not a degree-granting program. Students receive their degree from the home department of their research supervisors. The department requirements apply.

NATURAL RESOURCES

Michael Mortimer, Head

Professors: Robert Hull; Patricia Raun; Marc Stern;

Professor of Practice: Jerry Abrams; Joseph Albert; Desiree DiMauro; Megan Draheim; Heather Eves; John Hadidian; Jennifer Jones; Adam Kalkstein; Courtney Kimmel; Marina Malamud; Daniel Marcucci; Kathleen Perkins; Kevin Rabinovitch; Marcy Schnitzer; Erwin Villiger; Paul Wagner; Louise Wise;

Adjunct Faculty: Caitlin Callahan; James Egenrieder; April Evans; Lindsay Key; Jennifer Lawrence; Caleb O'Brien; Jason Papacosma; Robert Sarikas;

Assistant Professor of Practice: Neil Dampier; Rachel Goldstein; Donna Palumbo-Miele;

Associate Professor of Practice: Susan Apollonio; Gary Barrett; Richard Dooley; Michelle Haynes; Omchand Mahdu;

MNR Info: ltkey@vt.edu

MNR Degree: https://cligs.vt.edu/master-s-degrees.html

The Master of Natural Resources (MNR) is a 30 credit hour degree designed for working professionals aiming to advance their careers or to shift to leadership roles in the environmental and sustainability fields or functions. Delivered through two flexible programs: Executive (hybrid in-person and virtual), and Online (virtual). Our innovative course delivery and instruction approach allows you to immediately apply what you learn to real-world challenges. We've been delivering online and hybrid graduate education for over a decade, so we're less disrupted than campus-based programs during times of change. Our faculty are virtual classroom professionals, and our student-to-instructor ratio is low. We're set up to support all of our students, and we have the experience, capacity, and resources to ensure your success. We offer an extensive curriculum of courses that address diverse environmental and sustainability issues.Students can apply for the MNR as a degree-seeking student, non-degree-seeking (Commonwealth Campus) student, or accelerated undergraduate/graduate program for Virginia Tech students. Flexible Formats: Diverse undergrad majors welcomed Environmental science background is NOT required Graduate in as few as 12 months 10-day overseas Global Study** No GRE; TOEFL may be required for international students Admission decisions are based on both academic and professional experience No additional cost for out-of-state or international students Executive program meets in-person 11 weekends per year: 1) in the Washington, DC metro area for five 3-day meetings; and 2) virtually for six 2-day meetings Online program coursework is delivered 100% virtual, and offers flexible completion times Click here to start your application ** As part of our mission to build leadership for global sustainability, the required NR 5114 Global Issues in ES course includes a 10-day in-person, team-based study abroad experience. Locations include: Argentina Finland Iceland Ireland Italy South Africa Spain Given the dynamic nature of travel at the moment, we are following Virginia Tech's travel and study abroad policies to inform our decisions on destinations and timing. Focus Areas: Required Core Courses + Biodiversity & Ecosystems Cities & Urban Systems Climate Change Environmental Policy Environmental Security Sustainable Business Water & Marine Systems Veterans benefits can be used to cover the cost of both degree program formats. Financial aid is available.Contact Lindsay Key (ltkey@vt.edu), our Academic Advisor, to discuss our graduate programs. For more information, click here to access our website.

SPECIAL FACILITIES

The Center for Leadership in Global Sustainability (CLiGS) is located near Washington, DC, at the Virginia Tech Research Center in Arlington (VTRC-A), a U.S. Green Building Council LEED-certified facility. The VTRC-A building is just one block from the Ballston Metro station and Interstate 66. It is also within walking distance of major government agency and association headquarters, including the National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), Office of Naval Research (ONR), US Fish & Wildlife Service (USFWS), and The Nature Conservancy (TNC). Get directions to the VTRC-A

DEGREES OFFERED

MNR Degree

Offered In (Virtual, National Capital Region)

TOEFL

Paper: (550.0)

iBT: (80.0)

Graduate in as few as 12 months Two formats designed for working professionals: Online and Executive (Hybrid) Diverse undergrad majors welcomed Curriculum and career coaching customized to your goals 10-day overseas Global Study Non-thesis professional graduate degree No GRE or environmental science background required TOEFL may be required for international students Financial aid is available No additional cost for out-of-state or international students Admission decisions are based on both academic and professional experience Click here to start your application For more information, click here to access our website.

GRADUATE COURSES (NR)

NR 5014:

Constructing Sustainablity

Synthesize ecological, economic, and solid dimensions of sustainable and resilient systems. Examine history, theory, current status, and future prospects of sustainability and resiliency as organizing principles for natural resource management professions. Situate science, policy, professional and civic institutions in sustainability efforts. Analysis sustainable and resilient bio-cultural systems. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5024:

Sustainability Case Studies

Theory, properties, methods, and writing of case studies useful to sustainability professionals. Application of case study to explain and help guide management and planning of natural resource systems, such as water, food and agriculture, climate, and energy. Generalize from specific cases to global situations. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5114:

Global Issues in Environmental Sustainability

Competencies sustainability professionals need to address global sustainability challenges and pursue sustainability careers globally. Situate specific country challenges in larger global trends. Investigate specific sustainability situations outside the US, including goals, strategies, and stakeholders. International travel experience; cultural competencies. Team/collaborative project management. May be repeated 2 times, visiting different countries and different content, for a maximum of nine credit hours. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5174:

Sustainability Systems

Systems thinking needed by sustainability professionals. Basic competencies, language, and confidence needed to engage with other experts in collaborative problem-solving processes of pressing global sustainability challenges. Focus on sustainability systems represented in the United Nations Sustainable Development Goals: water, climate, agriculture, energy, poverty, urbanization, global material flows, biodiversity. System properties and other leverage points for influencing change. Collaborative problem-solving skills needed to work on multidisciplinary teams. Double loop learning and reframing problems and questions. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Online Lecture

Instruction Type(s): Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5184:

Adaptive Management

Conservation strategies and tools needed by sustainability professionals. Concept mapping, threat assessment, socio-cultural context evaluation, biodiversity threat-mitigation strategies, monitoring, evaluation for natural resource conservation. Professional skills for working in conservation organizations (i.e., writing, team work, budgeting, management planning, personnel estimates). Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5194:

Environmental Ethics

In depth analysis of current and past environmental issues in context of ethical and philosophical considerations starting from individual and group ethics and moving toward global and societal ethics. Addresses the interaction between influences and pressures such as social justice, cultural traditions, politics, science, technology, and religion and environmental ethics. Explores practical application of professional ethics to the resource decision-making process regarding current environmental issues. Graduate standing required, and National Capital Region students only.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5204:

Water Conflict & Management

Freshwater conflict issues and management for environmental sustainability professionals. Amount, quality, and distribution of freshwater in the US and globally. Major US and global water management agencies and programs. Impacts of local needs, cultures, and laws on water conflict. Case studies of water management and water conflicts in US and globally. Water conflict management. Water refugees. Pre: Graduate standing; restricted to online Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Online Lecture

Instruction Type(s): Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5214:

Urban Water Systems

Urban water systems and planning challenges for sustainability professionals. Case studies of contemporary urban water problems and solutions from North America and globally. Water, hydrology, green infrastructure, and rapid urbanization. Water and emergency management. Connection of urban water system to the regional landscape. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Online Lecture

Instruction Type(s): Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5244:

Innovating Water Partnerships

Water partnership tools for sustainability professionals. Regulating, financing, planning, and delivery of typical and alternative water sector projects. Technical aspects of the storm, clean, and drinking water sectors, regulatory and legislative issues, funding and financing challenges and innovations needed for partnerships. Strategies and governance of partnerships. Emphasis on public-private partnerships, Community-Based Public-Private Partnership, and Community-Based Public-Private Performance Partnership. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5264:

Watershed Stewardship

Watershed stewardship theory and practices for sustainability professionals. Identification, mapping, evaluation of peri-urban and rural watershed characteristics. Watershed threat assessment and restoration planning. Stewardship programming promoting water quality monitoring, public education, and advocacy. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5274:

Infrastructure for Resilience

Infrastructure design and development for urban sustainability and resilience. Focus on the interface of engineered, natural, and urban systems relevant to practicing sustainability professionals. Contemporary case studies illustrating innovations, processes, stakeholders, policies, and challenges of infrastructure planning for resiliency. Foundation for interdisciplinary team work on infrastructure planning. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5284:

Coastal & Marine Management

Science, management, planning, and policy for sustainability professionals working in coastal and marine environments. Social, economic, and environmental interactions that cause coastal and marine system problems. National and international policy. Coastal zone management strategies and marine spatial planning. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Online Lecture

Instruction Type(s): Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5344:

International Environmental Law & Policy

Purpose, scope, and justification of international environmental law and

policy. Sources of international laws and conventions and their respective strengths and weaknesses; assessment and enhancement of their effectiveness. Mechanisms to assess and facilitate implementation and compliance. Non-environmental actors and regimes. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5394:
Transboundary Resource Management
Cultural, social, geographic, and political dimensions of transboundary management for sustainability professionals. Types of boundaries. Natural resources boundary management needs and challenges when managing resources across boundaries. Strategies and best practices for transboundary resource management. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5424:
Urban Wildlife
Provides a topical and historical overview of the field of urban wildlife and issues encompassed by wildlife in cities and towns. Focus will be on the structure and nature of cities as ecosystems. The role of wildlife within urban ecosystems and the relationships of people to wild animals will be explored. Graduate standing required. National Capital Region students only.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5434:
Human-Wildlife Conflicts
Resolving human-wildlife conflicts in urbanizing environments. Legal and regulatory policy tools. Social science theory and facilitation tools for cooperation, collaboration, innovation, and conflict resolution applied to human-wildlife interactions. Social and ecological benefits and costs of managing conflicts. Human-wildlife ethics. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Online Lecture
Instruction Type(s): Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5454:
Biodiversity Stewardship
Biodiversity science useful to sustainability professionals stewarding community conservation efforts. Mapping and documenting biodiversity; setting biodiversity goals; challenges of climate change, water use, habitat loss, and invasive species. Roles of government agencies, advocacy groups, and businesses in biodiversity stewardship. Biodiversity partnerships. Generating support for stewardship with community awareness and citizen science. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Online Lecture
Instruction Type(s): Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5464:
Biodiversity Policy
Biodiversity policy tools for practicing sustainability professionals. International conventions and US laws protecting biological diversity, threatened and endangered species, and habitats. Tools and approaches for monitoring and assessing convention effectiveness. Policy obstacles and adaptive management responses. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5524:
Climate Change Science
Climate change science needed by sustainability professionals. Causes and consequences of climate change. Greenhouse gas accounting for major emission sources. Science needed to compare strategies for

mitigation, carbon sequestration, and adaptation. Function of major international climate science networks and organizations. Communicating climate science with different audiences. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5534:

Climate Change Policy

Policy tools needed by sustainability professionals to address climate change. US and International policies and efforts to address climate issues. Business policies for adaptation and mitigation. Climate justice. Local government policy tools for mitigation, adaptation, sequestration. Climate geoengineering. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5544:

Climate Adaptation and Mitigation Planning

Competencies needed to develop and implement strategic climate mitigation, adaptation, and resilience plans at local to national scales. Impacts of climate change. Climate vulnerability assessment for communities, environments, and businesses. Strategic mitigation, adaptation, and resilience approaches for sustainability. Scenario planning at local and national scales and in developed and developing countries. Communication, process, justice, and politics of implementation. Limits of adaptation. Climate adaptation and resilience planning. Restricted to Virtual Campus students. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5634:

Urban Ecology

Theory and practice of urban ecology. The science and policy of urban ecosystems. Local, regional, and global aspects of urban ecological processes. Social, historical, and political dimensions of urban ecosystem management and environmental governance. Strategies for sustainable urban development. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5674:

Environmental Forsenics

Environmental forensics for sustainability professionals. US and international policies and laws that define enivronmental crimes such as illegal trade in wildlife; smuggling of ozone-depleting substances; illicit trade of hazardous waste; illegal, unregulated, and unreported fishing; and illegal logging and trade in timber. Trends and differences of environmental harm and crime. Drivers and motivations of environmental crime. Environmental forensic practices. Communication skills for environmental forensic situations. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): NR 5684
Corequisite(s):

NR 5694:

Food Policy Sustainability

Environmental, economic, and social impacts of food systems relevant to natural resource sustainability professionals. Production, processing, distribution, and consumption components of food systems. Implications on food systems of contemporary issues such global supply chains, urban/rural divide, climate change, poverty, local and organic food, equity, biotechnology, foreign policy, development, national security, political instability, and human health. Strategies and collaborative efforts among business, government, and nongovernmental actors addressing sustainable food challenges. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

NR 5724:

Conservation Ecology

Explores the interdisciplinary knowledge, theories, and research related to natural resource management and conservation. Emphasis will be on the synthesis and integration of knowledge, skills and abilities required to develop innovative approaches to sustain resource development as conservation issues become more complex. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5814:

Business Sustainability Applications

Business and corporate sustainability theory and best practices for environmental sustainability professionals. Business motivations for sustainability. Corporate Social Responsibility and sustainability programs and practices. Markets and demand for green goods and sustainable brands. Global trends in markets and demographics. Supply chain management for climate and other sustainability challenges. Sustainable dimensions of investing, reporting, employee recruitment and retention, insurance, and risk management. Circular economy policy and theory. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5824:

Sustainability Accounting and Reporting

Accounting, evaluation, compliance, and reporting practices needed by sustainability professionals. Governance by disclosure through accountability and transparency. Applications include greenhouse gas, water, and human rights. Labels, certification, standards, and roundtables. Emphasis on reporting for businesses and government organizations. International and sectoral differences in sustainability reporting platforms and practices. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Online Lecture

Instruction Type(s): Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5844:

Leadership for Sustainability

Leadership tools needed by practicing sustainability professionals. Leadership theory for wicked situations facilitating direction, alignment, commitment. Leadership practices at four levels of social organization: individual, team, organization, network. Individual level tools include self-awareness of personality traits, conflict and influence style, integrity, trust. Team tools include principles, feedback, project management, active listening. Organization tools include strategic planning, indicators, organizational change. Network level tools include boundary spanning, cross-sector collaboration, partnering. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5854:

Leadership Communication for Sustainability Professionals

Persuasive communication and communication for collaboration within teams and within and across organizations focused on sustainability topics. Influence skills such as emotional intelligence, self-awareness, empathy, active listening, influence without authority. Professional communication best practices, including framing and presentation skills. Personalized plan to develop communication competencies. Pre: Graduate standing; restricted to Virtual Campus students.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5864:

Sustainability Science

Roles and limits of natural resources and the environment in relation to human, political, social, and economic goals and aspirations. Holistic and systemic focus on core questions of sustainability science including: examining interactions between human and natural systems; evaluating emerging models and conceptualizations of Earth-society sustainability;

assessing impacts of long-term trends in nature-society interactions; determining limits of resilience and sources of vulnerability for such interactive systems; developing incentive structures for guiding society toward more sustainable trajectories for interacting with the Earth; and harnessing science and technology to address sustainability goals. Graduate standing required. National Capital Region students only.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5874:
Strategies for Sustainability
Strategies to influence sustainability outcomes. Focus on social science approaches to influencing and explaining human behavior. Applied projects focused on interventions to address sustainability challenges. Pre: Graduate standing; restricted to Virtual Campus students.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Online Lecture
Instruction Type(s): Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5884:
Topics in Natural Resources
Advanced exploration of topical studies related to natural resources science, policy, and management. Topics and formats will vary, and course may be taken for credit more than once up to a total of 6 credits. Graduate standing required. National Capital Region students only.
Credit Hour(s): 1 TO 3
Lecture Hour(s): 1 TO 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5904:
Project and Report
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

NR 5954:
Study Abroad
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5964:
Field Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

NR 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NR 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

NR 6104:

Advanced Topics in Remote Sensing

In-depth coverage of advanced topics in the field of remote sensing selected to cover emerging techniques and technologies. Examples of topics, which will differ each semester, include field data in support of remote sensing, accuracy assessment, and hyperspectral remote sensing. Critical assessment of the ways in which remotely sensed data and information are employed in varied scientific disciplines and by society.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): GEOG 4354 OR GEOS 4354, (FOR 5254 OR FREC 5254), GEOG 5104 OR (FOR 5104 OR FREC 5104)

Corequisite(s):

NEUROSCIENCE

Sarah Clinton, Head

Associate Professors: Elizabeth Gilbert; Kendra Sewall;

Assistant Professors: Matthew Buczynski; Daniel English; Ann Gregus; Georgia Hodes; William Howe;

General Contact: neurograd@vt.edu

Graduate Contact: molsen1@vt.edu

Graduate Contact: nlangow3@vt.edu

Graduate Site: https://neuroscience.vt.edu/graduate.html

Note that the final deadline for application submission is February 1 Priority is given to applications submitted before December 1 Our Ph.D. students will apply the fundamentals of brain functioning in states of health and disease to new neuroscience discovery. We aim to provide students with a deep understanding of the structure and function of the brain and nervous system, the brain in healthy and diseased states across the lifespan, and the most relevant neurotechnology approaches and tools needed to investigate the brain and nervous system. Our students will learn how to conduct neuroscience research, how that research applies to healthy brain development and functioning, and how these processes go awry in neurological disorders. Our graduates will be prepared for employment in academia, industry and government agencies, as well as business and research settings that seek to understand, translate, implement, and communicate scientific principles in neuroscience. Our ResearchCellular, Molecular, Systems and Computational NeuroscienceUsing organisms from flies to humans, neuroscience researchers at Virginia Tech are exploring how the brain develops, how the brain ages, how neurons and glia interreact with one another to create functional circuits and how these circuits create or modulate behavior, such as learning and sleep. Our researchers are looking at these questions in the healthy brain, in neurodevelopmental disorders such as autism, in psychiatric disease, in neurodegenerative diseases including Parkinson and Alzheimer disease, in drug abuse, and brain injury.Our program Rotations Career Development Workshop Series Competitive Stipend, Tuition and >90% Healthcare coverage After one semester of research rotations and core neuroscience coursework, our PhD candidates and their mentors work together to identify additional neuroscience coursework and electives that shape each student's individual academic experience. Courses can be selected such that they support each students' research project and interests. PhD students of our research-intensive program will apply the fundamentals of brain functioning in states of health and disease to new neuroscience discovery.Our graduatesOur graduates are prepared for employment in academia, industry and government agencies, as well as business and research settings that seek to understand, translate, implement, and communicate scientific principles in neuroscience.

SPECIAL FACILITIES

Please visit our website for information Neuroscience PhD WebsiteYou can also email: neurograd@vt.edu

Neuroscience PhD Facilities

Facilities for this program can be found in the following locations:Sandy Hall, Life Sciences1, ICTAS II, Steger Hall, Corporate Research Center

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

Neuroscience PhD requirements: 96 Total Credit Hour minimumfor additional details visit our website Neuroscience PhD VT Neuroscience core (18 credits) NEUR 5004: Principles in Neuroscience (3 credits) NEUR 5014: Fundamentals of Cellular Neuroscience (3 credits) NEUR 5024: Neuroanatomy and Systems Neuroscience (3 credits) NEUR 5074: Current Topics in Neuroscience (1 credit x 4 = 4 credits) STAT 5615: Statistics in Research (3 credits) Laboratory Rotations: 1. NEUR 5374: Research Experience in Neuroscience (2 credits) Restricted Electives (6-12 credits) Students will select a minimum of 6 credit hours and a maximum of 12 credit hours from a prescribed list of courses. Selected coursework must be approved by the student's advisor. NEUR 5034G: Advanced Diseases of the Nervous System (3 credits) NEUR 5054: Developmental Neuroscience (3 credits) NEUR 5064: Cognitive and Behavioral Neuroscience (3 credits) NEUR 5314G: Advanced Genetics of Neuroscience (3 credits) NEUR 5364G: Advanced Neuroscience of Language and Communication Disorders (3 credits) NEUR 5514G: Advanced Neuroimmunology (3 credits) NEUR 5814G: Advanced Nutritional Neuroscience (3 credits) NEUR 5914: Neuroscience of Drug Development (3 credits) NEUR 6014: Glial Biology (3 credits) Free Electives (6-12 credits) Students will select a minimum of 6 credit hours and a maximum of 12 credit hours of graduate coursework at the 5000 level or higher. All courses must be approved by the student's advisor as part of the Plan of Study. Courses can come from any graduate course offerings at the institution. Independent Research Independent Research is conducted with a thesis advisor throughout the duration of the program. A thesis advisor is selected at the end of the first semester in the program following the two laboratory rotations.No standardized tests are required for entry into the program.

GRADUATE COURSES (NEUR)

NEUR 5004:

Principles of Neuroscience

Structure of the nervous system, membrane properties, and electrical properties of neuronal cells. Neurotransmitter systems, synapse structure and function. Overview of neural development, sensory and motor systems, memory, emotion, decision making, and behavior. Theories to study neurological structures and functions. Assessment of scientific literature. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5014:

Fundamentals of Cellular Neuroscience

Fundamentals of molecular signaling in the nervous system. Underlying neuronal signaling that includes the channels, transporters and pumps. Methods to study synaptic plasticity, structure and function of nervous system cells. Current understanding of the cellular and molecular basis of nervous system disorders. Assessment of scientific literature. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5024:

Neuroanatomy and Systems Neuroscience

Anatomy and function of the human central and peripheral nervous system, including gross and microscopic structure of major neural circuits that govern motor and sensory systems, autonomic function, memory, emotion, motivation and attention. Diseases and disorders associated with brain region malfunction. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5034G:

Advanced Diseases of the Nervous System

Common brain and Central Nervous System (CNS) disorders ranging from trauma to autism. Genetic, molecules and cellular changes in disease. Therapeutic implications and development of novel drugs. Challenges in drug discovery and implementation of personalized medicine. Ethical issues regarding genetic findings. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5054:

Developmental Neuroscience

Molecular and cellular processes underlying neural circuit formation, including neural induction, cell differentiation, cell fate determination, axon guidance, neuronal migration, synapse formation, sex differentiation, the role of neurotrophic factors, and cell death in vertebrate and invertebrate animal models. Gene regulation during critical periods of neural development that define neurogenesis and gliogenesis. Clinical problems in developmental neuroscience. Writing. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5064:

Cognitive & Behavioral Neuroscience

Concepts and methods in cognitive neuroscience. Neural bases of various mental functions including sensation, memory, attention, motivation and reward, emotion, decision making, sleep, language and social cognition. Treatment of neurological and mental disorders. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5074:

Current Topics in Neuroscience

Discussion of emergent topics, theory and techniques in contemporary neuroscience research. Current research literature review of select topic. Scientific communication, ethics, and research integrity. May be repeated with different topics for a maximum of 4 credits. Pre: Graduate Standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5314G:

Advanced Genetics in Neuroscience

Concepts of classical, modern genetics and epigenetics as they relate to neuroscience. Practical applications including genome-wide association (GWAS), next-generation sequencing, epigenetics, genome editing and screening methods. Use of model organisms in neurogenetic disorders research. Relationship of genetics and its influences on theoretical and practical issues in neurological and neurodevelopmental disorders. Personalized medicine in neurodevelopmental and neurogenetic disorders. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5364G:

Advanced Neuroscience of Language & Communication Disorders

Concepts of language as distinctive human behavior and central to social life. Neural underpinnings of humans ability to speak and understand language. Neurologic processing of language comprehension and production in healthy and language-impaired individuals. Auditory and visual word recognition, reading, understanding speech, representation of word meaning, language production, and bilingualism. Neuroethology of communication and neurological disorders of communication: dyslexia, stuttering, and aphasia. Theoretical issues in language processing and converging evidence from different techniques and animal models addressing these issues. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5374:

Research Experience in Neuroscience

Hands-on research experience in neuroscience. Hypothesis testing, experimental design, research methods, accurate record keeping, and data analysis. Scientific literature evaluation, problem solving, and scientific communication skills. May be repeated once for a maximum of four credits. Co: 5004 or 5014 or 5024.

Credit Hour(s): 2

Lecture Hour(s):

Instruction Type(s): Lab, VB

Instruction Type(s): Lab, VB

Prerequisite(s):

Corequisite(s):

NEUR 5514G:

Advanced Neuroimmunology

Immune system and assorted roles in psychiatric and neurological disorders. Details of cell type, functions and signaling of the peripheral and central immune system, and sympathetic nervous system. Cross-talk between the brain and immune system across the blood brain barrier and circumventricular organs. Treatment options for autoimmune diseases and psychopathy. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5814G:

Advanced Nutritional Neuroscience

Concepts in nutritional aspects of neuroscience. Energy metabolism in central nervous system and brain regulating ingestive behavior. Communication with peripheral organs, regulation of whole body energy homeostasis, brain physiology and pathology on molecular and cellular level. Role of appetite neurocircuitry in formulation of practical solutions to societal problems such as nutrition, eating disorders, and obesity. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5844:

Computational Neuroscience

Concepts in modeling theoretical neuroscience. Study of information processing in the central nervous system integrating neuroscience, mathematics, computer science, and engineering. Basic information theory. Neural coding schemes using MATLAB. Advanced signal processing techniques for the analysis of neural data, neural modeling, and model architectures. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

NEUR 6014:

Glial Biology

Cell biology and physiology of glial cells during synaptogenesis, myelination, blood-brain barrier formation and maintenance. Interactions of glial cells with neurons, the vasculature and immune system. Role of glial cells in the clearance of waste products and in the development and progression of neurological diseases. Animal models in glial biology research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): NEUR 5014 OR TBMH 5014

Corequisite(s):

NEUR 6034:

Diseases of the Nervous System

Common brain and Central Nervous System (CNS) disorders including epilepsy, acute CNS trauma, neurodegenerative diseases, neurodevelopmental disorders, and certain mental illnesses. Genetic, molecular, and cellular changes in disease. Therapeutic implications, current limitations, and development of novel drugs. Use of animals to model human disease. Challenges in drug discovery and implementation of personalized medicine. Ethical issues regarding genetic findings.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): NEUR 5004 OR TBMH 5014

Corequisite(s):

NEUR 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NEUR 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Research, Online Lecture

Instruction Type(s): Lecture, Research, Online Lecture

Prerequisite(s):

Corequisite(s):

NUCLEAR ENGINEERING

Brian Lattimer, Interim Head

Emeriti Faculty: Diana Farkas;

Professors: Alireza Haghighat; Jonathan Link; Roop Mahajan; Danesh Tafti; Jinsuo Zhang;

Associate Professors: Xianming Bai; Celine Hin; Yang Liu; Sonja Schmid;

Robert E Hord Jr Professor: Alireza Haghighat;

Associate Professor of Practice: Mark Pierson;

Lewis A. Hester Chair in Engineering: Roop Mahajan;

William S. Cross Professor: Danesh Tafti;

Adjunct Faculty: Juliana Pacheco Duarte; Luka Snoj; James Turso;

Graduate Contact: haghighat@vt.edu

General Contact: negrad@vt.edu

General Contact: arjones@vt.edu

ME Department: http://www.me.vt.edu

Bursar's Office - Tuition: http://www.bursar.vt.edu/

University Scholarships and Financial Aid: http://www.finaid.vt.edu/

Timetable of Classes: https://banweb.banner.vt.edu/ssb/prod/HZSKVTSC.P_DispRequest

Fellowships and Scholarships: https://nuclear.ncr.vt.edu/admission/funding-opportunities

Research: https://nuclear.ncr.vt.edu/research

Student Medical Insurance: http://risk.controller.vt.edu/studentmedicalinsurance.html

Dates & Deadlines: http://registrar.vt.edu/dates-deadlines-accordion.html

New Student Checklist: http://graduateschool.vt.edu/admissions/getting-started-as-a-student/new-student-checklist.html

College of Engineering: http://www.eng.vt.edu/

Historical Time Table of Classes: https://banweb.banner.vt.edu/ssb/prod/HZSKVTSC.P_DispHistorical

Office of Student Veterans Services: https://www.veterans.vt.edu/

Immigration Services: http://graduateschool.vt.edu/student-life/immigration-services.html

Nuclear Engineering Prog.: https://nuclear.ncr.vt.edu

Funding opportunities: https://graduateschool.vt.edu/funding.html

Research Groups: https://nuclear.ncr.vt.edu/research/groups

The nuclear engineering program (NEP) at Virginia Tech is a multi-disciplinary program with activities in nuclear power, nuclear nonproliferation and security, radiation therapy and diagnostics, and nuclear policy. Housed in the Department of Mechanical Engineering, the nuclear engineering program offers graduate degrees at two campuses including Blacksburg and the National Capital Region (NCR), an accelerated MEng program in collaboration with the US Naval Academy, and an undergraduate minor in Nuclear Engineering.Students in other disciplines may earn a graduate certificate in Nuclear Engineering (Blacksburg, NCR, and online), or a graduate certificate in Nuclear Science, Technology, and Policy (NSTEP, Blacksburg and NCR). The NSTEP Graduate Certificate is a joint program between Nuclear Engineering, the Science, Technology, and Society Department, and the School of Public and International Affairs (SPIA). The Nuclear Engineering faculty are engaged in different applications of nuclear science and engineering including power, security, medicine, and policy. To accomplish its research and educational mission, the NEP has established collaborations with other VT programs such as Mechanical Engineering, Materials Science and Engineering, Physics, Computer Science and Visualization, School of Public and International Affairs, and Science, Technology and Society. Collaboration outside of VT continues to grow and includes a study abroad opportunity at the Josef Stefan Institute in Slovenia. Faculty from all of these programs are working with the NEP faculty on different educational and research activities.For further information about NEP, visit https://nuclear.ncr.vt.edu

SPECIAL FACILITIES

The reintroduction of the Nuclear Engineering degree program has led to facilities available across the Commonwealth of Virginia, including Falls Church and Blacksburg. Interdisciplinary research projects cross several departmental boundaries to provide richer opportunities for graduate students. For further information on nuclear facilities, visit https://nuclear.ncr.vt.edu .

Access to the TRIGA MARK II research reactor, JSI, Slovenia.

Under a MOU between the Jozef Stefan Institute (JSI) and Virginia Tech, the graduate students and faculty can access the JSI's TRIGA Mark II research reactor and related facilities if they identify projects of mutual interest. Through such projects, the VT students will be trained and provided assistance in conducting experiments. The JSI's TRIGA Mark II Reactor began its operation on May 1966. The power of the reactor is 250 kW. TRIGA utilizes solid fuel elements in which the zirconium hydride moderator is homogeneously mixed 20% or 70% enriched uranium. Because of the unique feature of this fuel, moderator elements have a prompt negative temperature coefficient of reactivity, which gives TRIGA its built-in safety. The reactor core consist of a lattice of cylindrical fuel-moderator elements and graphite (dummy) elements at the bottom of the 6 m high tank full of light water which is used for cooling and radiation protection. The reactor has the following experimental and irradiation facilities: 2 radial beam channels, 2 tangential beam channels, 2 thermal columns, 40 position rotary specimen rack, pneumatic transfer tube and central thimble.

Access to the US Naval Academy nuclear facilities

Under a partnership between the US Naval Academy (USNA) and Virginia Tech, with support from the USNA faculty and staff, the VT nuclear engineering faculty and students can conduct experiments in support of their research activities at the USNA, Annapolis, MD.

Goodwin Hall & Northern Virginia Center, Falls Church

The Goodwin Hall and the Northern Virginia Center (Falls Church) house the Nuclear Engineering program offices.

Heat Transfer and Safety Laboratory

Director   Juliana Pacheco DuarteHeat Transfer and Safety Laboratory (HEATS) conducts experimental and computational investigation of two-phase flow phenomena such as post-critical heat flux heat transfer, boiling, and condensation. Our research efforts focus on the thermal-hydraulics and safety analysis of advanced nuclear systems to improve safety, security, and economic features of the next generation of nuclear reactors. We work with verification and validation of subchannel and system thermal-hydraulics codes and inverse heat transfer problems.

Multi-physics for Advanced Reactor Simulation (MARS) Center - Greater Washington DC

Director: Prof. Alireza Haghighat, Nuclear Engineering ProgramObjectives: Development of novel methodologies and computer codes for design and analysis of advanced (safer, sustainable, and more efficient) nuclear reactors, such as the Molten Salt Reactor (MSR) designs. The Center has attracted national and international collaborations on preparation of proposals, new funding, publications and invited talks. It is envisioned that MARS will enable Virginia Tech to become an internationally recognized hub for development of multiphysics modeling and simulation for Advanced Nuclear Reactors. VT Participating Programs: Nuclear Engineering (Celine Hin, Yang Liu, Jinsuo Zhang), Material Science and Engineering (Celine Hin), Mechanical Engineering, Physics (Jonathan Link, Patrick Huber and Bruce Vogelaar), and VT Visualization Center (Nicholas Polys) National and International partners: U.S. Universities: Georgia Tech (Bojan Petrovic, Farzad Rahnema, and Dingkang Zhang); North Carolina State University (Maria Avramova, Kostadin Ivanov). U.S. Industry: Southern Company Services (Nick Smith); with letters of support from TerraPower, Trasnsatomic Power, Elysium Industries, Flibe Energy. U.S. National Laboratories: Oak Ridge National Laboratories (Kevin Robb, Ben Betzler) International Organizations: Jozef Stefan Institute (Luka Snoj), Politecnico di Milano, Italy (Antonio Cammi), Politecnico di Torino, Italy (Piero Ravetto, Sandra Dulla, Co-PIs), and University of Ljubljana (Iztok Tiselj)

Multiphase Flow and Thermal-hydraulics Laboratory (MFTL)

Director: Prof. Yang Liu - The laboratory performs experimental and computational studies on various multiphase flow and reactor thermal-hydraulics topics. In the first area, we study the full spectrum of two-phase flow regimes that are of practical interest, ranging from bubble nucleation to film and droplet dynamics. Research activities include advanced instrumentation development, experimental studies, and model development for both 1-D system codes and 3-D CFD codes. In the area of reactor thermal-hydraulics, the focus is on reactor safety related issues. Specific topics include air entrainment in the emergency core cooling system, flow structure development in rod bundles, flow induced vibration on piping elements, passive safety systems, and spent fuel pool safety. MFTL (Multiphase Flow and Thermal-hydraulics Lab) has several test loops for two-phase flow experiment and instrumentation development. These test loops are equipped with high-precision instruments including magnetic flow meters, air mass flow meters, and differential pressure transducers. An existing high-speed imaging system consists of multiple (up to five) high-speed cameras, with an attainable frame rate up to 500,000 fps and resolution up to 6016x1024 pixels. A fast X-ray line-detector system can provide X-ray imaging at spatial resolution of 100 micrometer and a frame rate exceeding 1000 Hz. MFTL also has the capability to develop in-house instrumentation systems, such as multi-sensor conductivity probes, impedance void meters, and film thickness sensors. The dedicated computing resources include a 64-core AMD Opteron workstation and several multi-core Intel Xeon based workstations. The lab has access to Virginia Tech's high-performance computing systems, which houses more than five high performance clusters and necessary software packages including ANSYS CFX, ANSYS FLUENT and OpenFOAM, to perform single- and multi-phase CFD simulations.

Nuclear Materials and Fuel Cycle Center

Director: Prof. Jinsuo Zhang, The Nuclear Materials and Fuel Cycle Center (NMFC) focuses on two research topics: material degradation in a nuclear reactor and electrochemical separation for nuclear applications. Degradation of structural materials including fuel cladding has been recognized as one of the key factors that affect the performance of a nuclear reactor, especially for Gen.IV advanced reactors. The material degradation can be due to the corrosive property of a nuclear coolant such as liquid metal, molten salt and high temperature water or the chemical reactions between different materials such as fuel cladding chemical interactions (FCCI). Electrochemical separation has been found to be an effective method to separate nuclear materials from spent nuclear fuels. The method is also one of the candidate methods for molten salt coolant purification. Specifically, the center focuses on studies of advanced used nuclear fuel reprocessing, material compatibility and materials corrosion in advanced and current nuclear reactors. Ongoing research activities are: 1) Nuclear Materials compatibility (materials corrosion/degradation), 2) Nuclear Fuel Cycle Technology; 3) Electrochemical Separation; 4) Nuclear Safeguards and nonproliferation; and 5) Advanced Coolant Materials (molten salt, liquid metal). The Center benefits from two recently established facilities: A Molten Salt Chemistry Loop for determination of chemical properties of molten salt fuel under high temperature.. Two specialized high-temperature water loops for investigation of materials performance in high temperature environments

Radiation Measurement and Simulation Laboratory (RMSL)

Director: Assoc. Prof. of Practice Mark Pierson The laboratory supports research activities in radiation detection and materials, radiation dosimetry, light-weight radiation shielding materials, radiation detection arrays, nuclear safeguards, design of passive and active interrogation systems, and benchmarking of particle transport codes. In addition, it provides modeling and simulation of the results. Finally, it provides radiation literacy through experiments conducted by students in the various nuclear engineering courses.Equipment included in the lab: Reverse electrode Germanium detector, 60% efficiency with hybrid cryostat Digital spectrum analyzer NaI and LaBr scintillation detectors Various radiation detection instruments and probes Lead-shielded counting systems 32 processor computational cluster with large panel displays for visualization

Virginia Tech's Advanced Research Computing

Virginia Tech's Advanced Research Computing: Advanced Research Computing (ARC) at Virginia Tech is an innovative and interdisciplinary environment advancing computational science, engineering and technology. Its mission is to:-Provide computing and visualization resources, support, and leadership to advance computational research at Virginia Tech.-Provide partnerships and support for joint faculty appointments in academic departments, building areas of excellence in computational science and engineering across disciplines, and providing opportunities for new innovation in scientific computing.-Offer educational programs and training on scientific computing, encouraging the development of knowledge and skills in computational tools and techniques for undergraduate, graduate and research faculty and staff.-Offer programs to stimulate and expand interdisciplinary and computational driven research activity at VT, including visiting researcher, travel, distinguished postdoctoral fellow and graduate student programs that provide new sources of support for collaboration, research, and development.-Affiliate with business, industry, and government to help drive economic development growth in Virginia by building connections between research and applications for emerging tools and techniques in computational science and engineering.-Collaborate with other computational science and engineering driven research centers in advancing knowledge and leading the evolution of scientific computing tools, techniques, and facilities that accelerate scientific discovery.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (620.0)

iBT: (105.0)

TOEFL Computer Based

Computer Based: CBT (260.0)

GRE

General: Verbal (150.0), Quantitative (165.0), Analytical (4.5)

Master of Science (MS) Degree RequirementsThe Master of Science degree requires a minimum of 30 credit hours of graduate coursework. Specific degree requirements are listed below.1. Core Courses (15 graded credit-hours): Four foundational topics in nuclear engineering and one mathematics/statistics course make up the core curriculum all degrees in nuclear engineering at VT.15 credit-hours of required courses: (1) NSEG 5124 Nuclear Reactor Analysis(2) NSEG 5204 Nuclear Fuel Cycle(3) NSEG 5604 Radiation Detection and Shielding (4) NSEG 5424 Reactor Thermal Hydraulics or MSE 5384G Advanced Nuclear Materials(5) 3 credit hours of graduate mathematics or statistics2. Elective Courses (6-9 credit-hours): Any science, engineering or mathematics 5000-level or higher courses as approved by the student's Advisory Committee are required. However, if only six credit-hours of NSEG 5994 are applied toward the degree instead of nine credit-hours (see Research Requirements below), the student must take an additional 3 credits of any science, engineering or mathematics 5000-level, or higher course, as approved by their Advisor, to satisfy the requirement for a total of 30 credit hours for the M.S. degree.The graded course work may include 5984/6984 Special Study. However, a student cannot exceed a maximum of 6 credit hours of 5974, 5984, and 6984. 3. Research Requirement: A minimum of 6 credit-hours of NSEG 5994 Research and Thesis, not to exceed 9 credit-hours, must be completed. Additional Requirements: All students must satisfactorily pass an oral final examination, write and successfully defend a thesis. Seminar Program: All students must participate in the nuclear engineering program seminar series. Full-time students enrolled on the Blacksburg campus must register for ME 5944 Mechanical Engineering Seminar.Ethics: All graduate students must meet the Graduate School's Ethics requirement. NE students may (1) enroll and complete GRAD 5014 Academic Integrity & Plagiarism or (2) complete the CITI program and ethics seminar requirement. Course work From Another Institution (MS): Per the Graduate School, not more than 50% of required graded course work from another institution may be transferred. All transferred course credits must have the grade of "B" or higher and must have been earned while enrolled as a graduate student. Transfer work is evaluated/approved when the Plan of Study is submitted. All transfer credits must be accompanied by transcripts which verify grades. Course descriptions are also required. Transfer courses on the Plan of Study must be approved by the student’s Advisory Committee.It is anticipated that students complete the MS program in two years following undergraduate studies in a nuclear related field, or with a minor in a nuclear related field. If a student already has a B.S. in Nuclear Engineering, they are expected to complete the MS program in less time, perhaps in as few as three semesters.No courses below the 5000 level will be accepted for graduate credit.

MEng Degree

Offered In (Virtual, Blacksburg, National Capital Region)

TOEFL

Paper: (620.0)

iBT: (105.0)

GRE

General: Verbal (150.0), Quantitative (165.0), Analytical (4.5)

TOEFL Computer Based Test

CBT Score: CBT Score (260.0)

Master of Engineering (MEng) Degree RequirementsThe Master of Engineering degree requires a minimum of 30 credit hours of graduate coursework. Specific degree requirements are listed below.1. Core Courses (15 graded credit-hours): Four foundational topics in nuclear engineering and one mathematics/statistics course make up the core curriculum for all degrees in nuclear engineering at VT.15 credit-hours of required courses:(1) NSEG 5124 Nuclear Reactor Analysis(2) NSEG 5204 Nuclear Fuel Cycle(3) NSEG 5604 Radiation Detection and Shielding (4) NSEG 5424 Reactor Thermal Hydraulics or MSE 5384G Advanced Nuclear Materials(5) 3 credit hours of graduate mathematics or statistics2. Elective Courses (9 credit-hours): Any science, engineering or mathematics 5000-level or higher courses as approved by the student's Advisory Committee are required. However, if only three credit-hours of NSEG 5904 are applied toward the degree instead of six credit-hours (see Research Requirements below), the student must take an additional 3 credits of any science, engineering or mathematics 5000-level, or higher course, as approved by their Advisor, to satisfy the requirement for a total of 30 credit hours for the MEng degree.The graded course work may include 5984/6984 Special Study. However, a student cannot exceed a maximum of 6 credit hours of 5974, 5984, and 6984.3. Project Requirement: A minimum of 3 credit-hours of NSEG 5904 Project and Report, not to exceed 6 credit hours, must be completed. Additional Requirements: All students must satisfactorily pass an oral final examination, write and successfully present a Project & Report.Seminar Program: All students must participate in the nuclear engineering program seminar series. Full-time students enrolled on the Blacksburg campus must enroll in ME 5994 Mechanical Engineering Seminar.Ethics: All graduate students must meet the Graduate School's Ethics requirement. NE students may (1) enroll and complete GRAD 5014 Academic Integrity & Plagiarism or (2) complete the CITI program and ethics seminar requirement. Course work From Another Institution: Per the Graduate School, not more than 50% of required graded course work from another institution may be transferred. All transferred course credits must have the grade of "B" or higher and must have been earned while enrolled as a graduate student. Transfer work is evaluated/approved when the Plan of Study is submitted. All transfer credits must be accompanied by transcripts which verify grades. Course descriptions are also required. Transfer courses on the Plan of Study must be approved by the student’s Advisory Committee.It is anticipated that students complete the MEng program in two years following undergraduate studies in a nuclear related field, or with a minor in a nuclear related field. If a student already has a B.S. in Nuclear Engineering, they are expected to complete the MEng program in less time, perhaps in as few as three semesters.No courses below the 5000 level will be accepted for graduate credit.

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (620.0)

iBT: (105.0)

GRE

General: Verbal (150.0), Quantitative (165.0), Analytical (4.5)

Computer Based TOEFL

CBT Score: CBT Score (260.0)

Doctor of Philosophy (Ph.D) Degree Requirements The PhD requires a minimum of 90 credit hours consisting of (1) 30 graded credit hours of core coursework, (2) 30 credit hours of research, and (3) 30 credit hours of enhancement courses which may consist of either research credits or graduate level courses taken from any unit of the University. Doctor of Philosophy Courses: A minimum of 30 graded credit hours of courses must be taken including the following:1. Core Courses (30 graded credit hours) which include four required courses and two mathematics/statistics courses: (1) NSEG 5124 Nuclear Reactor Analysis(2) NSEG 5204 Nuclear Fuel Cycle(3) NSEG 5604 Radiation Detection and Shielding (4) NSEG 5424 Reactor Thermal Hydraulics(5) MSE 5384G Advanced Nuclear Materials(6) NSEG 5134 Monte Carlo Methods of Particle Transport(7) NSEG 6124 Advanced Nuclear Reactor Analysis(8) NSEG 6334 Nuclear Reactor Safety Analysis(9) 6 credit hours of graduate-level mathematics or statistics The graded course work may include 5984/6984 Special Study. However, a student cannot exceed a maximum of 12 credit hours of 5974, 5984, and 6984. Doctor of Philosophy Research Requirement: A minimum of 30 credit hours of NSEG 7994 Research & Dissertation must be completed successfully. Doctor of Philosophy Enhancement Requirement: A minimum of 30 additional credit hours consisting of a combination of either graduate coursework (5000 level or higher) from any unit of the University and/or research and dissertation credits (NSEG 7994), as approved by the student’s Advisory Committee. These credits are tailored for the specific research topic and background of the student. Additional in-depth courses related to the student’s research area, if applicable, are included under this requirement.   Moreover, students who plan to enter academia after completion of their Ph.D are encouraged to take electives such as GRAD 5104 Preparing the Future Professoriate and ENGE 5014 Foundations of Engineering Education. Those planning to enter industry are encouraged to take electives such as GRAD 5314 Future Industrial Professional in Science and Engineering. Obtaining a Graduate Certificate in the Future Professoriate or other areas is also encouraged. These electives will also satisfy part of the 30 credit hours enhancement requirement. The graded course work may include 5984/6984 Special Study. However, a student cannot exceed a maximum of 12 credit hours of 5974, 5984, and 6984. Additional Requirements: All students must satisfactorily pass the qualifying, preliminary, and oral final examinations, write and successfully defend a dissertation, and complete a residency experience through full-time enrollment on the Virginia Tech Blacksburg campus or National Capital Region campus for two consecutive semesters. Seminar Program: All students must participate in the nuclear engineering program seminar series. Full-time students enrolled on the Blacksburg campus must enroll in ME 5994 Mechanical Engineering Seminar.Ethics: All graduate students must meet the Graduate School's Ethics requirement. NE students may (1) enroll and complete GRAD 5014 Academic Integrity & Plagiarism or (2) complete the CITI program and ethics seminar requirement. Course Work From Another Institution: Per the Graduate School, not more than 50% of required graded course work from another institution may be transferred. All transferred course credits must have the grade of "B" or higher and must have been earned while enrolled as a graduate student. Transfer work is evaluated/approved when the Plan of Study is submitted. All transfer credits must be accompanied by transcripts which verify grades. Course descriptions are also required. Transfer courses on the Plan of Study must be approved by the student’s Advisory Committee.No courses below the 5000 level will be accepted for graduate credit toward the Doctor of Philosophy in Nuclear Engineering.

MEng Degree

Offered In (Blacksburg, National Capital Region)

Accelerated BS/MEng Program (USNA)Students from the US Naval Academy who are currently seeking an undergraduate degree in Nuclear Engineering are eligible for the accelerated graduate program leading to the Masters of Engineering (MEng) degree in the Nuclear Engineering Program at Virginia Tech The requirements for this program are listed below. Undergraduate students from USNA must be accepted into the program prior to the spring semester of the academic year. Students qualifying for the program must be in the last 12 months of their undergraduate degree and are expected to complete their degree by the end of the spring semester of the academic year. Once completion of the undergraduate degree has been verified, students accepted into this accelerated program will be classified as regular graduate students. Students will take 10 credits of graded coursework during the spring semester that may be used towards meeting the MEng degree requirement. Students will not double count any courses for the undergraduate USNA and graduate VT degrees. Students admitted in the program must have a GPA of 3.0 or better. Students must maintain a GPA of 3.0 or better during their first semester (spring semester of the academic year) to be accepted as regular graduate students upon their graduation from USNA. Courses must not be taken pass/fail if a graded option is available. Master of Engineering (MEng) Degree RequirementsThe Master of Engineering degree requires a minimum of 30 credit hours of graduate coursework. Specific degree requirements are listed below.1. Core Courses (15 graded credit-hours): Four foundational topics in nuclear engineering and one mathematics/statistics course make up the core curriculum for all degrees in nuclear engineering at VT.15 credit-hours of required courses:(1) NSEG 5124 Nuclear Reactor Analysis(2) NSEG 5204 Nuclear Fuel Cycle(3) NSEG 5604 Radiation Detection and Shielding (4) NSEG 5424 Reactor Thermal Hydraulics or MSE 5384G Advanced Nuclear Materials(5) 3 credit hours of graduate mathematics or statistics2. Elective Courses (9 credit-hours): Any science, engineering or mathematics 5000-level or higher courses as approved by the student's Advisory Committee are required. However, if only three credit-hours of NSEG 5904 are applied toward the degree instead of six credit-hours (see Research Requirements below), the student must take an additional 3 credits of any science, engineering or mathematics 5000-level, or higher course, as approved by their Advisor, to satisfy the requirement for a total of 30 credit hours for the MEng degree.The graded course work may include 5984/6984 Special Study. However, a student cannot exceed a maximum of 6 credit hours of 5974, 5984, and 6984.3. Project Requirement: A minimum of 3 credit-hours of NSEG 5904 Project and Report, not to exceed 6 credit hours, must be completed. Additional Requirements: All students must satisfactorily pass an oral final examination, write and successfully present a Project & Report.Seminar Program: All students must participate in the nuclear engineering program seminar series. Full-time students enrolled on the Blacksburg campus must enroll in ME 5994 Mechanical Engineering Seminar.Ethics: All graduate students must meet the Graduate School's Ethics requirement. NE students may (1) enroll and complete GRAD 5014 Academic Integrity & Plagiarism or (2) complete the CITI program and ethics seminar requirement.

GRADUATE COURSES (NSEG)

NSEG 5104:

Applied Mathematics for Nuclear Engineers

Mathematical modeling. Complex numbers and operations. Matrix theory. Vector analysis and multivariable operators. Review of ordinary differential equations. Analytical methods for solving partial differential equations. Computational methods for solving partial differential equations in spatial and time dimensions including finite differences, finite volume, and discrete ordinates methods. Emphasis on applications associated with reactor physics and reactor thermal hydraulics. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NSEG 5114:

Nuclear Eng Fundamentals

A foundation course in nuclear engineering. Neutron physics, reactor theory and kinetics, basic reactor design and operation, and overall power plant operation. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NSEG 5124:

Nuclear Reactor Analysis

Nuclear reactions and fission process. The fission chain reaction. Neutron diffusion and moderation. One-speed diffusion model of a nuclear reactor. Neutron slowing and multigroup diffusion theory. Nuclear reactor kinetics. Introduction to reactor core physics design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   NSEG 5114

Corequisite(s):

NSEG 5134:

Monte Carlo Particle Transport

Basic particle transport concepts. Random processes, random number generation techniques, fundamental formulation of Monte Carlo, sampling procedures, and fundamentals of probability and statistics. Monte Carlo algorithms for particle transport, non-analog Monte Carlo method, formulations for different variance reduction techniques, and tallying procedures. Methodologies for parallelization and vectorization of the Monte Carlo methods, and examples of the Monte Carlo method for simulation of various real-life applications. Graduate standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NSEG 5204:

Nuclear Fuel Cycle

Uranium nuclear fuel cycle: mining, conversion, enrichment, fuel manufacturing, in-core fuel management and refueling, spent fuel storage, reprocessing/recycling and final disposition as waste in a geologic repository. Introduction to nuclear safeguards and nonproliferation as applied to each step of the cycle. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NSEG 5214:

Nuclear Plant Systems & Ops

Pressurized and boiling water reactors, detailed system functions and operation, reactor plant startup and shutdown procedures, reactor trip and casualty procedures, reactor transient response analysis, reactor plant licensing, ethics and integrity in the nuclear industry.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): NSEG 5114
Corequisite(s):

NSEG 5284 (SPIA 5284) (STS 5284):

Nuclear Nonproliferation, Safeguards, and Security

Technical essentials, policy analysis, theoretical perspectives of nuclear energy and nuclear nonproliferation. Fundamentals of the nuclear fuel cycle, management of international safeguards, threat of nuclear terrorism, and challenges for global nuclear industry. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NSEG 5424:

Reactor Thermal Hydraulics

Fundamental processes of heat generation and transport in nuclear reactors. Heat generation by fission and radiation interactions; spatial distribution of heat generation; heat transport by conduction and convection. Effects of boiling and critical heat flux. Fundamentals of reactor thermal and hydraulic design.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): NSEG 5114
Corequisite(s):

NSEG 5504 (MSE 5504):

Radiation Effects on Metals and Alloys

Radiation effects on metals and alloys. Interaction between particles and atoms, radiation damage, displacement of atoms, diffusion of point defects, radiation-induced segregation, phase instability, transmutation products, irradiated material mechanical properties. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NSEG 5514:

Structural Materials Degradation in Nuclear Power Systems

High temperature failure mechanisms and corrosion in applications of nuclear engineering to include material compatibility and materials selection for nuclear power systems. In-depth treatment of high-temperature corrosion, stress-corrosion cracking, and the effect of non-aqueous coolants. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NSEG 5604:

Radiation Detect & Shielding

Radioactive decay, interaction of charged particles and photons with matter, methods of radiation detection and radiation dosimetry, counting statistics, external radiation protection using time, distance and shielding. Pre-requisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

NSEG 5904:

Project and Report

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

NSEG 5944:

Nuclear Engineering Graduate Seminar

A series of seminar lectures or panels on various nuclear engineering topics by invited U.S. and international guests from industry, government organizations, national laboratories, other universities, or Nuclear Engineering program PhD students and faculty. May be repeated 5 times with different content for a maximum of 6 credits. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NSEG 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

NSEG 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NSEG 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

NSEG 6124:

Particle Transport Theory, Methods and Applications

Neutral particle interactions and related cross sections. Linear Boltzmann equation in “forward” and “adjoint” forms and their applications. Perturbation and variational techniques for particle transport problems. Different numerical methods for solving the linear Boltzmann equation; limitations of these methods for solving real-life problems, and parallel and serial computational implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): NSEG 5124

Corequisite(s):

NSEG 6204:

Advanced Nuclear Fuel Cycle Processing

Advanced nuclear fuel cycle processing in the applications of spent nuclear fuel treatment to include material separation (volatilization and electrochemical separations), separation equipment, and safeguards and nonproliferation concerns during processing. In-depth treatment of aqueous reprocessing, liquid/liquid extraction, and pyrochemical reprocessing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): NSEG 5204

Corequisite(s):

NSEG 6334:

Nuclear Reactor Safety

Hazards of nuclear reactors; analysis of hypothetical design basis accidents; engineered safeguards and safety design principles; nuclear criticality safety; reactor containment; reactor safety codes; and probabilistic risk assessment.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): NSEG 5114

Corequisite(s):

NSEG 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NSEG 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

OCEAN ENGINEERING

Ella Atkins, Head

Professors: Jonathan Black; Stefano Brizzolara; Alan Brown; Robert Canfield; Olivier Coutier-Delgosha; William Devenport; Mazen Farhood; Rakesh Kapania; Kevin Lowe; Eric Paterson; Michael Philen; Mark Psiaki; Pradeep Raj; Shane Ross; Christopher Roy; Joseph Schetz; Gary Seidel; Kevin Shinpaugh; Cornel Sultan; Craig Woolsey;

Associate Professors: Colin Adams; William Alexander; Scott England; Yao Fu; Christine Gilbert; Luca Massa; Jonathan Pitt; Bhuvana Srinivasan; Kevin Wang; Gregory Young;

Assistant Professors: Seongim Choi; Mathieu Joerger;

NAVSEA Professor of Naval Ship Design: Alan Brown;

Norris and Laura Mitchell Professor of Aerospace Engineering: Rakesh Kapania;

Rolls-Royce Commonwealth Professor of Marine Propulsion: Eric Paterson;

Adjunct Faculty: Mayuresh Patil;

Fred D. Durham Endowed Chair Professor: Joseph Schetz;

Kevin Crofton Professor: Mark Psiaki;

Research Associate Professors: Aurelien Borgoltz; Nanyaporn Intaratep;

Research Assistant Professors: Matthew Kuester;

Professor of Practice: Harry Artis;

Graduate Contact: gradadvise-g@vt.edu

Student Handbook: https://www.aoe.vt.edu/content/dam/aoe_vt_edu/programs/graduate/forms/AOE_Graduate_P-P.pdf

Graduate Site: https://www.aoe.vt.edu/graduate.html

Master of Science Degree The Department of Aerospace and Ocean Engineering offers a Master of Science Degree in Aerospace Engineering and in Ocean Engineering. Each of these degrees has two options, a Master of Science with or without thesis. Although both degrees require the same number of credit hours for graduation, the thesis option requires some of these credits be devoted to a research project. The non-thesis option can be obtained by taking only course work, or it can include credits for a project and report. Such a project and report is generally not research oriented, but deals with other aspects of an engineering problem and may involve a team of students. In order to ensure that all our students can communicate with scientists and engineers outside their primary field of interest, all students take at least one course in the general areas of aerodynamics, structures, flight mechanics and control, and numerical methods. In addition, students in the non-thesis program are required to take additional courses in their area of study. Students in this program have the opportunity to work on advanced research projects in the three areas mentioned previously as well as in the interdisciplinary arena where familiarity with two or more disciplines is required. As a result many of our students are in a position to satisfy the rapidly growing demand for well rounded engineers and scientists. Students following the thesis route work with faculty that have both national and international reputations in their respective areas of research. These areas pose exciting new challenges to the students who have the opportunity to work closely with their faculty advisor on current problems. These problems reflect the latest interests in new advancements in science and technology by NASA, Navy, Air Force, and various aerospace and non-aerospace industries. Our masters students do significant hands-on research and often work in teams with other masters and Ph.D. students on wide-range of topics, some focused in a newly developing area, and some multidisciplinary in nature. These activities include state-of-the art research in aerodynamics, structures, flight dynamics and control, and multidisciplinary analysis and design. Students are encouraged to present their research results at conferences and in archival journals tied to industry and/or government or sponsored projects and include interaction with personnel and facilities from those organizations.The requirements for the degrees focused on applied physics or applied mathematics are slightly different from those of the other categories in that some required courses from the Aerospace and Ocean Engineering Department are replaced with others from either Physics or Mathematics respectively. These programs are specially tailored for students whose backgrounds are from outside the engineering environment and are interested in applying their skills to solving aerospace problems. Such programs encourage interaction with disciplines outside the usual engineering environment and result in new approaches to analyzing and solving problems.

SPECIAL FACILITIES

Research in Aerospace and Ocean Engineering poses exciting new challenges to the students who have the opportunity to work closely with their faculty advisor on current problems. These problems reflect the latest interests in new advancements in science and technology by NASA, Navy, Air Force, and various aerospace and non-aerospace industries. Our graduate students do significant hands-on research and often work in teams with other graduate students on wide-range of topics, some focused in a newly developing area, and some multidisciplinary in nature. These activities include state-of-the-art research in aerodynamics, structures, flight dynamics and control, and multidisciplinary analysis and design Students are encouraged to present their research results at conferences and in archival journals tied to industry and/or government sponsored projects and include interaction with personnel and facilities from those organizations. Research in Aerospace and Ocean Engineering poses exciting new challenges to the students who have the opportunity to work closely with their faculty advisor on current problems. These problems reflect the latest interests in new advancements in science and technology by NASA, Navy, Air Force, and various aerospace and non-aerospace industries. Our graduate students do significant hands-on research and often work in teams with other graduate students on wide-range of topics, some focused in a newly developing area, and some multidisciplinary in nature. These activities include state-of-the art research in aerodynamics, structures, flight dynamics and control, and multidisciplinary analysis and design Students are encouraged to present their research results at conferences and in archival journals tied to industry and/or government sponsored projects and include interaction with personnel and facilities from those organizations.

AOE 3D Print Laboratory

Students must send an email request to aoe-3dprint-g@vt.edu to gain access to submit printing jobs. This email will be used to create a user account and you will receive an invite to join GrabCAD Shop.

Hydro Elasticity Laboratory

The Hydroelasticity Laboratory is an experimental Fluid-Structure Interaction facility for Ocean structures in the Kevin T. Crofton Department of Aerospace and Ocean Engineering. The focus of this group is to understand fundamental physics of various fluid-structure interaction problems. One important problem that is currently being studied is of slamming impacts on high-speed planing craft, those vessels which are hydrodynamically loaded. The first phase of the experiment, which is shown in the photos, is of a flexible wedge drop experiment. Measurements are taken of hydrodynamic pressure, kinematics of the structure, and strain. Currently, the water tank is being redesigned to be larger in size to accommodate different types of experiments and to not restrict the jet resulting from the wedge impact. The new tank will also support flow visualization experiments. Another phase of the slamming experiment will be conducted in the Tow Tank facility and will allow for more degrees of freedom to be examined. Please contact Dr. Ikeda-Gilbert (cikeda@vt.edu) for more information.

Hydrodynamics Laboratory

(Randolph 33)Facilities: Drag-Reduction Test Facility, Water Tunnel

Marine Robotics Laboratory

(Randolph 15)

Ship Dynamics Lab

The VT AOE Ship Dynamics Laboratory provides space for cutting edge analytical, computational, and experimental research into vessel stability, capsize, and quiescence. Amongst other resources, the laboratory is home to two dual-processor high performance Linux workstations to enable computationally efficient simulation of seakeeping and strongly nonlinear capsize behavior over large parameter ranges.

Towing Basin

Modeling ship resistance is done by towing a model in a towing basin. The basin, located in the basement of Norris Hall is made of reinforced concrete painted with a chemical and moisture resistant enamel. The width of the basin is 6 feet and the maximum water depth is 4 feet. The overall length of the basin is 98 feet but the first 4 feet and the last 24 feet are used for braking the carriage. The usable test length is then approximately 70 feet. There are two glass walled observation pits along the side of the tank, one located approximately in the middle of the test region and the other pit located at the starting end. The observation pit at the starting end is intended for use in the study of wave reflection and absorption. The carriage and rails were designed and constructed by the firm of Kempf and Remmers of Hamburg, Germany and were shipped in sub-assemblies to Virginia Tech. The allowable tolerance on rail height was 0.1mm. Wedges were used to give final straight alignment of each rail. The allowable tolerance on alignment was 0.2mm. Final alignment was done optically. After final adjustments in height were made, the space between the bearing plates and the bottom of the rail was filled with concrete. A 400 V DC motor drives the carriage through a gear reduction box. The DC power is supplied from a 220 V AC motor-generator set. A maximum speed of the carriage of 3.0 meters per second can be obtained. The carriage braking is done automatically using trips installed at both ends. An emergency brake button is also on the console. The brake is of the magnetic clutch type and brakes the DC motor directly. The brake is applied if power to the carriage is interrupted. Braking deceleration is 0.7 meter per second per second. Ocean Engineering undergraduate students perform two experiments in the basin. They test the resistance of both a surface ship and a submarine.

DEGREES OFFERED

MS Degree

Offered In (Virtual, Blacksburg)

TOEFL

iBT: (90.0)

GRE

General: Verbal, Quantitative, Analytical

Master of Science Requirements: Thesis and (Non-Thesis) 1. A minimum of 30 credit hours is required. • For thesis students, up to 9 credit hours may be allotted for Research and Thesis (AOE 5994). • For non-thesis students, up to 6 credit hours may be allotted for Project and Report (AOE 5904). 2. A minimum of 15 credit hours (18 for non-thesis) of graded course work numbered 5000 and higher must be included in the Plan of Study. These credit hours do not include the AOE Seminar (AOE 5944), Research and Thesis (AOE 5994) hours, or Project and Report (AOE 5904) hours. 3. A maximum of 6 credit hours of 5974 and 5984 is allowed. 4. A maximum of 6 credit hours of approved 4000 level course work is allowed. 5. Up to 50% of the courses on the Plan of Study may be transferred from a graduate program at another institution, subject to the approval of the Advisory Committee. Substitution of a transferred course for a specific required course is subject to the approval of the Graduate Program Director or a designee, usually the responsible instructor. Each transferred course must have a grade of B (3.0/4.0) or better. 6. Breadth Requirement: All MS OE students are required to take at least one course each in the three disciplinary areas identified below. Fluid Mechanics • AOE 5104, Advanced Aero and Hydrodynamics; • AOE 5124, Aero and Hydroacoustics; • AOE 5144, Boundary Layer Theory; • AOE 5304, Advanced Naval Architecture. Dynamics and Control • AOE 5334, Advanced Ship Dynamics; • AOE 5444G, Advanced Dynamics of High-Speed Craft. Structures and

Materials • AOE 5024, Vehicle Structures; • AOE 5074, Advanced Ship Structural Analysis. 7. Math Requirement: All MS Students are required to take at least one course (of three credits or more) focused on graduate-level mathematics, statistics, or numerical methods. A sample list of courses satisfying this requirement is given in Appendix B. The MS Advisory Committee can approve other courses that have majority of their learning outcomes on advanced mathematics, statistics, or numerical methods. 8. Non-thesis MS OE students must take at least two of the following courses: • AOE 5074, Advanced Ship Structural Analysis; • AOE 5084, Submarine Design; • AOE 5304, Advanced Naval Architecture; • AOE 5314, Naval and Marine Engineering System Design; • AOE 5324, Principles of Naval Engineering; • AOE 5334, Advanced Ship Dynamics; • AOE 5444G, Advanced Dynamics of High-Speed Craft

GRADUATE COURSES (AOE)

AOE 5024:

Vehicle Structures

Exact and approximate methods for analysis and design of aerospace and marine structures. Stresses, strains, constitutive equations, boundary value problems, and two-dimensional elasticity; torsion; variational methods; virtual work and energy principles; structural mechanics theorems; traditional approximate methods; and laminated plates.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5034 (ESM 5304):

Mechanical and Structural Vibrations

Free and forced vibrations of single-degree-of-freedom systems, multi-degree-of-freedom systems, continuous systems including strings, rods, bars, and beams. Natural frequencies and modes. Rigid Body modes. Proportional and nonproportional damping. Response to harmonic, periodic, and nonperiodic excitations. Solutions by modal analysis, direct integration and Fourier Series. Approximate methods including assumed modes and the Rayleigh-Ritz method. Advanced topics chosen by instructor.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5054 (ESM 5454):

Elastic Stability

Stability of elastic structural components under conservative loads; precise definitions of stability; energy approaches; Rayleigh-Ritz and Galerkin methods; and applications to column, arches, plates, and shells.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 3124 (UG) OR CEE 3404 (UG)

Corequisite(s):

AOE 5064 (ESM 5064):

Structural Optimization

Structural optimization via calculus of variations. Application of techniques of mathematical programming to optimize trusses, beams, frames, columns, and other structures. Sensitivity calculation of structural response. Approximation techniques and dual and optimality criteria methods. A background in optimization is necessary.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5074:

Advanced Ship Structural Analysis

Analysis of plate bending, buckling, and ultimate strength using computational tools and methods. Calculation of elastic buckling of stiffened panels. Eigenvalue methods for buckling and vibration. Incremental plastic collapse; other progressive collapse. Ultimate strength of large structural modules due to combined loads. Introductory level finite element analysis. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5084:

Submarine Design

Application of engineering disciplines to the design of a steam turbine propelled nuclear submarine. The disciplines involved are fluid mechanics, solid state mechanics, structures, machine design, thermodynamics and heat transfer.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5104:

Advanced Aero and Hydrodynamics

Vector analysis concepts; fluid stress and strain, kinematics of fluid flows including vorticity; dynamics of inviscid incompressible flow; and potential flow theory with applications to lifting and non-lifting bodies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5114:

High Speed Aerodynamics

Aerothermodynamic phenomena and shock waves. Linearized subsonic and supersonic flow past planar surfaces and bodies of revolution. Theory of transonic aerodynamics including study of mixed flow. Similarity laws. Mathematical representation of inviscid compressible flows in equilibrium. Potential function, stream function, rotationality and geometrical considerations. Method of characteristics applied to hyperbolic flow fields. Discussion of techniques for solution of elliptic flow fields. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5124:

Aero and Hydroacoustics

Aeroacoustics for students familiar with the foundations of fluid dynamics. Fundamental theories of aeroacoustics, including Lighthill's analogy, the Ffowes-Williams Hawkings equation and Goldstein's equation. Mathematical methods needed to and apply these theories, including correlation and spectral methods for turbulent flows. Applications include the prediction of leading and trailing edge noise are taught. Relevant experimental methods, including facilities, corrections, instrumentation, signal processing and phased microphone arrays.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5104

Corequisite(s):

AOE 5144:

Boundary Layer Theory and Heat Transfer

Conservation equations and constitutive relations, exact Navier Stokes solutions; boundary layer approximation and special solutions; approximate methods; compressibility and heat and mass transfer effects; and numerical methods and simple turbulence models.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5104

Corequisite(s):

AOE 5154:

Data Analysis in Fluid Dynamics

Data analysis techniques and their role in fluid dynamics research. Fundamental tools for statistical analysis of random processes. Ways to obtain physical meaning from fluid dynamics data. Techniques for single-point statistics and correlation-based, multi-point statistics of data fields. Hypothesis-driven study of complex flow phenomena. Analysis of unsteady and turbulent flow emphasized. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5164:

Fluid-Structure Interaction

Review of essential elements of elastic vibration and basic fluid mechanics; hydroelasticity based on potential flow theory; acoustic-structure interaction; dynamic aeroelasticity of airfoils; analytical solution of selected 1- and 2-D model problems; overview of computational models and methods for nonlinear fluid-structure interaction problems (e.g., partitioned and monolithic procedures, arbitrary Lagrangian-Eulerian, immersed/embedded boundary, interface tracking). Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5174 (ECE 5174):

Introduction to Plasma Science

Underlying physical processes and basic computational techniques for laboratory, space, and technological plasma environments including single particle motion, fluid and kinetic theory of plasmas, plasma waves and instabilities, diffusion and resistivity, and nonlinear effects. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5184 (ME 5184):

High Speed Propulsion

Analysis of high-speed air breathing propulsion concepts for hypersonic flight. Aerodynamic inlet design and flow path integration. Cycle analyses, flight performance, and design limitations given a set of design requirements. Aerothermodynamic analysis of ramjets, scramjets, and detonation wave engines. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5204:

Vehicle Dynamics and Control

Relevant rigid body kinematics and dynamics fundamentals for vehicles such as aircraft, spacecraft, and ships. Provides foundation for advanced courses and research on dynamics and control of vehicles. Review of particle motion and application to aircraft performance and satellite orbital mechanics. Rigorous modeling of rotational and translational motion of rigid bodies. Linearization of equations of motion for stability analysis, modal analysis, control system synthesis, with introduction to classical control system concepts. Sensors and actuators commonly used on vehicles. Specific examples from aircraft, missiles, spacecraft, rockets, ships, and submersibles. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5224G:

Advanced Atmospheric and Ocean Vehicle Model Identification

Atmospheric and ocean vehicle dynamic modeling from experimental data including: experiment design; model structure determination; parameter and state estimation; and data analysis methods. Regression and maximum likelihood approaches. Time and frequency domain formulations. Applications to airplanes, rotorcraft, surface vessels, and undersea vehicles. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5234:

Orbital Mechanics

Lagranges equations of motion, two-body problem, conic sections, Keplers laws, orbit determination. Multi-body problems and integrals of motion. Fundamentals of perturbation theory, variation of parameters, and Lagranges planetary equations. Regularization and alternative formulations of equations of motion.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5304:

Advanced Naval Architecture

Engineering analysis methods for evaluating the hydrostatic, hydrodynamic, and structural characteristics of surface ships and submarines. Methods employed in ship design include analytical, statistical, and experimental approaches. Both hull and propulsor analysis techniques are covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5314:

Naval and Marine Engineering Systems Design

Concepts, theory, and methods for the engineering, design, integration, and assessment of ship mechanical, electrical, fluid and naval systems. Description and functional physics of system components, system architecture, and the modeling of system effectiveness for multidisciplinary and multi-objective design optimization. System integration, interfaces, and analyses considering ship arrangements, signatures, system deactivation diagrams and vulnerability, reliability, maintenance, system power, shock and weapons effects and damage control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5324

Corequisite(s):

AOE 5315:

Naval Ship Design

Capstone naval ship design concept exploration including the study and application of the system engineering process to the simultaneous development of naval ship requirements, selection of ship technologies, and definition of a baseline naval ship design. Hullform, machinery, ship synthesis and balance, metrics (including Overall Measure of Effectiveness, technology risk, and cost) and design optimization in the context of a naval ship design project.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5304, AOE 5314, AOE 5334, AOE 5074

Corequisite(s):

AOE 5316:

Naval Ship Design

Development of a naval ship baseline design including hullform, combat systems, topside arrangements, internal subdivision and tankage, power and propulsion, auxiliary machinery, general arrangements, machinery arrangements, human systems, structural design, assessments of intact and damage stability, shock and survivability, weights, space, seakeeping, cost, risk, and overall balance and feasibility.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5315

Corequisite(s):

AOE 5324:

Principles of Naval Engineering with Applications

Basic functional principles and theory for naval engineering systems and system engineering processes. Particular emphasis is given to: naval missions; combat system performance including radar; underwater acoustics and sonar; ballistics; weapon propulsion and architecture; weapons effects; ship survivability including underwater explosion and shock waves; surface ship and submarine hydrostatics, balance and feasibility analysis; and total ship integration. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5334:

Advanced Ship Dynamics

Derivation of the equations of motion of a ship; waves and wave forces on structures; description of wave statistics and spectral representation in a given sea state; ship response in regular waves; ship response in random waves. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5354 (ISE 5314):

Industrial Robotics

Design, programming principles, and performance evaluation methods for robotic systems employed for both classical and advanced manufacturing applications. Common design choices for industrial robots, underlying dynamical models, and their performance are analyzed. Position and attitude representation techniques, direct and inverse kinematic problems, singularity analysis through a study of the Jacobian matrix, and dynamical modeling of industrial robots are discussed. Both classical and advanced control techniques are synthesized to guarantee high performance both in nominal and off-nominal conditions. Elements of computer vision for industrial robotics are presented. Pre: Graduate standing.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5404:

Numerical Methods for Aerospace and Ocean Engineering

Numerical methods for solving differential equations and optimization problems in aerospace and ocean engineering. Iterative methods for solving systems of linear and nonlinear equations. Rate of convergence. Matrix factorization techniques. Solution of least squares problems. Numerical methods for multivariate unconstrained and constrained optimization. Finite difference method for ordinary and (elliptic, parabolic, and hyperbolic) partial differential equations. Order-of-accuracy and numerical stability analysis. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5434G (ME 5434):

Advanced Introduction to Computational Fluid Dynamics

Euler and Navier-Stokes equations governing the flow of gas and liquids. Mathematical character of partial differential equations. Discretization approaches with a focus on the finite difference method. Explicit and implicit solution techniques and their numerical stability. Introduction to verification, validation, and uncertainty quantification for computational fluid dynamics predictions. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5444G:

Advance Dynamics of High Speed Marine Craft

Study of the dynamics of high-speed craft, including surface effects ships, hydrofoil vessels, semi-displacement monohulls and catamarans, and planning vessels. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5604:

Modeling Composites Damage

Algorithms, techniques and tools applied in multiscale modeling of damage and failure in composite materials. Continuum level models, mesoscale models, and atomistic models. Analytic and computational techniques for capturing damage effects and conducting length scale transitions. Homogenization techniques, multiple scale expansion, finite element analysis, continuum damage models, cohesive zone models, dislocation dynamics, particle methods, and molecular statics and dynamics. Role of mesh-independent and meshless methods in modeling damage evolution. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5614:

Modeling Multifunct Composites

Algorithms, techniques and tools applied in multiscale modeling of multifunctional composite materials. Continuum mechanics mathematical models for mechanical, thermal, and electromagnetic behaviors and linear and nonlinear couplings between them in active materials. Origins of coupled material response in active materials. Analytic and computational micromechanics to predict macroscale multifunctional composite properties based on active material constituents at the microscale.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5654 (ECE 5164):

Intro to Space Science I

Describes the space environment from the sun to the earths upper atmosphere. Fundamental concepts in space plasma physics will be presented, as needed, throughout the course. Numerous examples of observations and data will be utilized to illustrate the environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment and its dynamic variability. An emphasis will be placed on the practical impacts of this environment (space weather) on modern technologies such as solid state devices, satellite technology, communication and global navigation systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): ECE 5105

AOE 5664:

Upper Atmosphere and Ionosphere

Fundamental concepts of solar-terrestrial physics; interaction of Earth's upper atmosphere and space environment with spacecraft; upper atmospheric composition, radiation, photochemistry and energy balance; structure of the upper atmosphere; impacts of transport and dynamics on the upper atmosphere; ionospheric composition, production and loss and its relation to Chapman theory; ionospheric structure; impacts of ionospheric electrodynamics; impacts of geomagnetic storms on the upper atmosphere and ionosphere; radio wave propagation; comparisons to other planets; details of atmospheric and ionosphere instrumentation. Pre: Graduate standing in Engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5734 (ME 5584) (ECE 5734):

Convex Optimization

Recognizing and solving convex optimization problems. Convex sets, functions, and optimization problems. Least-squares, linear, and quadratic optimization. Geometric and semidefinite programming. Vector optimization. Duality theory. Convex relaxations. Approximation, fitting, and statistical estimation. Geometric problems. Control and trajectory planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 5744 (ME 5544) (ECE 5744):

Linear Systems Theory

Advanced introduction to the theory of time-varying and time-invariant linear systems represented by state equations; solutions of linear systems, uniform stability and other stability criteria, uniform observability and controllability, state feedback and observers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 (UG) OR ECE 4405 OR ECE 4624 (UG) OR ECE 4634 OR ECE 4634 (UG) OR ECE 4634 OR ME 4504 (UG) OR ME 4504 OR AOE 4004 (UG) OR AOE 4004

Corequisite(s):

AOE 5754 (ME 5554) (ECE 5754):

Applied Linear Systems

Develop an applied understanding of state-space representations for linear time invariant multi-input multi-output dynamic systems in both time domain and frequency domain. Introduction to modern state-space control methods; state feedback and output feedback. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4405 (UG) OR ECE 4405 OR ECE 4624 (UG) OR ECE 4624 OR ECE 4634 (UG) OR ECE 4634 OR ME 4504 (UG) OR ME 4504 OR AOE 4004 (UG) OR AOE 4004

Corequisite(s):

AOE 5764 (ME 5564) (ECE 5764):

Applied Linear Control

Analysis and design of sampled-data systems, extraction of discrete-time dynamic models from experimental data, and implementation of dynamic compensators on digital processors. In-depth design experience with LQR optimal control and an introduction to Kalman filtering. Realistic design problems with numerical simulations of practical implementations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5744 OR AOE 5754 OR ME 5554 OR ME 5544 OR ECE 5744 OR ECE 5754

Corequisite(s):

AOE 5774 (ME 5574) (ECE 5774):

Nonlinear Systems Theory

Introduction to the theory of systems of coupled, nonlinear, time-varying ordinary differential equations: existence and uniqueness of solutions; continuous dependence on parameters; stability of equilibria and stability

analysis techniques; input-to-state stability; input-output stability; nonlinear design techniques including input-state and input-output feedback linearization, backstepping, and sliding mode control. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5784:

Model-Based Estimation and Kalman Filtering

Modeling of estimation problems including batch and dynamic problems; stochastic linear and nonlinear dynamic system models including Markov process models; batch nonlinear least-squares estimation; linear Kalman filtering and smoothing algorithms for dynamic problems; square-root information filtering and smoothing; nonlinear Kalman filtering, including the extended Kalman filter, the unscented Kalman filter, and particle filters; covariance analysis; filtering applications. Co: 5744 or 5754 or ECE 5744 or ME 5544 or ECE 5754 or ME 5554.
Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5844:

Wave Mechanics

Linear wave theory including boundary value problems, wave transformation in shallow waters, long waves, and engineering properties of waves. Introduction to nonlinear wave theories. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5894:

Final Examination

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5904:

Project and Report

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Lecture, Online Research
Instruction Type(s): Research, Online Lecture, Online Research
Prerequisite(s):
Corequisite(s):

AOE 5944:

Seminar

Discussion of current research topics in Aerospace and Ocean Engineering by local and visiting scholars. This course cannot be used to fulfill the minimum requirements of 30 hours toward the Masters Degree or 90 hours toward the Ph.D. Degree in Aerospace and Ocean Engineering. May be repeated.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5974:

Independent Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

AOE 5984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

AOE 6024:

Aeroelasticity

Discussion of the aeroelastic phenomena including flutter, divergence, control surface effectiveness, and lift redistribution; and introduction to traditional and modern methods of analysis and remedies for aeroelastic problems of flight vehicles.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5034, AOE 5104, AOE 5214

Corequisite(s):

AOE 6064:

Reliability-Based Design Optimization

Analyze uncertainties associated with mechanical and structural design. Methods to model various uncertainties in a design using stochastic expansions and other probabilistic analysis tools. Computation of safety index and structural reliability using efficient techniques for implicit functions. Optimize designs under uncertainty.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5064 OR AOE 5734 OR ECE 5734 OR ISE 5406 OR MATH 5485 OR ME 5584

Corequisite(s):

AOE 6114:

Transonic Aerodynamics

Basic features of transonic flows, similarity methods, and hodograph methods. Major emphasis on finite difference procedures including type dependent relaxation procedures for potential flows and time asymptotic Euler solutions. Grid generation methods, inverse design procedures, unsteady flow, wind tunnel/wall interference, and shock wave/boundary layer interactions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 3114 (UG), AOE 4404 (UG), AOE 5144

Corequisite(s):

AOE 6124:

Hypersonic Aerodynamics

Theory of inviscid hypersonic flows; blunt body and Newtonian aerodynamics; nonlinear small disturbance theory; and approximate methods and comparisons with experiment. Viscous hypersonic flow theory; skin friction and heat transfer on blunt and slender bodies; and vorticity, entropy layer, and viscous-inviscid inter-action effects.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5114

Corequisite(s):

AOE 6145:

Computational Fluid Dynamics

Computational methods for incompressible, compressible, and viscous fluid flows. Theoretical and numerical developments for wave equation, heat equation, Poissons equation, and Burgers equation. Applications to inviscid subsonic, transonic, and supersonic flows, viscous boundary layer, Navier Stokes, thin layer equations, and grid generation techniques. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 6154:

Turbulent Shear Flow

Advanced treatment of the physical phenomena of turbulent boundary layers, jets, wakes, and duct flows; coherent structures; entrainment, bursting, vortex dynamics; and unsteady, wall, and freestream turbulence effects.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5144 (UG)

Corequisite(s):

AOE 6174 (ECE 6174):

Computational Plasma Dynamics

Computational techniques for investigating processes in plasmas over a broad range of spatial and temporal scales. Investigation of physical processes including electrodynamics, waves and turbulence, space propulsion, spacecraft environmental effects and various laboratory applications. Computational techniques including full Particle-in-Cell (PIC), hybrid (fluid-electron, PIC ion), magnetohydrodynamics MHD and two-fluid methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5174 OR AOE 5174

Corequisite(s):

AOE 6204:

Adv Vehicle Dynamics & Control

Topics in the dynamics and control of systems including airplanes, helicopters, spacecraft, and structures. Physics and data-based modeling from the control system designers perspective. Structure of the control-oriented equations of motion in relation to robust control design. Bio-inspired design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5204

Corequisite(s):

AOE 6234:

Advanced Orbital Mechanics

Canonical dynamics and applications to the two and three body problems. Classical and canonical variation of parameter equations of motion. Forces influencing Earth satellite motion are surveyed. Applications to Earth satellite motion. Additional topics from resonance, stability, periodic motion, numerical integration, and orbit determination.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5234

Corequisite(s):

AOE 6254 (ESM 6254):

Turbulence Modeling and Simulation

In-depth study into the modeling and simulation of turbulent flows. Derivation of exact equations describing turbulent flows along with various approaches to turbulent closure. Turbulence modeling via algebraic, RANS, and Reynolds stress models. Turbulence simulation via DNS, LES and hybrid RANS/LES approaches and analysis of results. Turbulence compressibility effects, body forces, boundary conditions, wall functions, sub-grid modeling approaches, turbulence anisotropy and stress invariants, and realizability. Strengths and weaknesses of the different modeling and simulation approaches. Role of numerics in different modeling approaches. Pre: Graduating standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

AOE 6314 (ESM 6314):

Advanced Dynamics

Fundamental concepts of analytical mechanics, variational principles, Lagranges equations, rigid-body kinematics and dynamics, Euler parameters, quasi-coordinates, Eulers equations, gyroscopic systems, Hamilton-Jacobi equation, transformation theory, introduction to optimal control theory, advanced concepts in stability theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ESM 5314

Corequisite(s):

AOE 6434 (ME 6434):

Computational Fluid Dynamics and Heat Transfer

Overview of numerical methods used in the study of computational fluid dynamics (CFD) and heat transfer. Spatio-temporal finite-difference, finite-volume discretizations, solution of linear systems with direct and iterative methods, algorithms for solving the Navier Stokes and energy equations, and turbulence modeling. Applications to inviscid subsonic, transonic, and supersonic flows and viscous boundary layer. Theory reinforced with hands on programming assignments and the application of commercial CFD packages to select problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 5404, ME 5314, ME 5104

Corequisite(s):

AOE 6444 (ME 6444) (CS 6444):

Verification and Validation in Scientific Computing

Applicable to scientific and engineering models described by partial differential or integral equations. Software engineering, code verification, and the method of manufactured solutions for generating exact solutions. Estimation of numerical approximation errors in scientific computing. Design and execution of experiments for model validation and model accuracy assessment. Propagation of aleatory and epistemic uncertainty through models. Estimation of total prediction uncertainty in scientific computing simulations. Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 6744 (ME 6544) (ECE 6744):
Linear Control Theory
Advanced introduction to the theory of optimal control of time-varying and time-invariant linear systems; Solutions to the linear-quadratic regulator, optimal filtering, and linear-quadratic-gaussian problems; Robustness analysis and techniques to enhance robustness of controllers.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 5744 OR ECE 5754 OR ME 5544 OR ME 5554 OR AOE 5744 OR AOE 5754
Corequisite(s):

AOE 6774 (ECE 6774) (ISE 6574) (ME 6574):
Adaptive Control Systems
Introduction to the theory and methodology used to design adaptive controllers for uncertain systems, addressing issue such as input constraints, disturbance rejection, partial measurements, and robustness.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)
Corequisite(s):

AOE 6974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

AOE 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

AOE 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

PHILOSOPHY

Kelly Trogdon, Head

Emeriti Faculty: Richard Burian; Deborah Mayo; Joseph Pitt;
Professors: James Klagge; Douglas Lind; Wendy Parker; Lydia Patton;
Associate Professors: Ashley Heflin; Benjamin Jantzen; Michael Moehler; Kelly Trogdon;
Assistant Professors: Mercedes Corredor; Gil Hersch; Daniel Hoek; Jordan MacKenzie; Rohan Sud; Philip Yaure;

Graduate Program Director: jmackenzie@vt.edu
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Graduate Site: https://liberalarts.vt.edu/departments-and-schools/department-of-philosophy/academic-programs/masters-in-philosophy.html
Placement Record: https://liberalarts.vt.edu/departments-and-schools/department-of-philosophy/academic-programs/masters-in-philosophy/placement.html

The Department of Philosophy's M.A. program is one of the top terminal M.A. programs in philosophy in the United States. Our faculty offer core graduate training in philosophy in the broadly analytic tradition, with particular strengths in the history of philosophy, value theory, and philosophy of science. Emerging areas of strength include core analytic philosophy (e.g. metaphysics and philosophy of language), social philosophy, and environmental philosophy. Many of our students enter with the intention of enriching their philosophical background and then going on to PhD studies in philosophy elsewhere.

SPECIAL FACILITIES

The Department of Philosophy has office space for all who are currently enrolled. There is also a department lounge/conference room (MJWS 215) for faculty/graduate student use. The Department has a seminar room (MJWS 225) where most graduate seminars are held.

Philosophy Facilities

The Department of Philosophy has office space for all graduate students who are currently enrolled.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

The M.A. degree requires a minimum of 30 credit hours of graduate level work. Students may complete the requirements for the M.A. degree through either the thesis or non-thesis tracks. Students pursuing the thesis track write a thesis and take at least 24 hours of regular coursework. Students pursuing the non-thesis track take at least 27 hours of regular coursework and complete a set of comprehensive exams at the conclusion of the two year program.

GRADUATE COURSES (PHIL)

PHIL 5004:

Graduate Proseminar in Philosophy

Develop key professional skills (writing, research, effective presenting, critical discussion). Gain familiarity with influential arguments and concepts from classic readings from 20th and 21st century analytic philosophy (including readings from metaphysics, epistemology, philosophy of mind and language, philosophy of science and mathematics, ethics, political philosophy, feminist philosophy, and the philosophy of race). Conduct independent philosophical research using appropriate databases. Learn how to produce abstracts, conference-length papers, and professional documents (e.g., annotated bibliographies, personal statements, curriculum vitae (CV)) in a way that coheres with philosophy’s professional norms. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5204:

Topics in the History of Philosophy

An advanced course focusing on particular topics in the history of philosophy. Special emphasis will be placed on ideas and disputes which were historically influential and continue to be philosophically significant. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5204G:

Intermediate Philosophy of Mind

Current issues in the philosophy of mind, such as relation of mind and body, status of the mental, knowledge of owns own and other minds, personal identity, consciousness, mentality of animals and machines, topics in the philosophy of psychology. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5214G:

Intermediate Metaphysics

Examination of central problems of metaphysics. Topics may include: existence, necessary truth, the problem of universals, causation, the identity of the self through time, free will. Attention will be given both to the historical development of these problems and to contemporary philosophical responses to them. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5224G:

Intermediate Epistemology

Theory of knowledge. Exploration of topics including the foundations (or lack of foundations) of knowledge, the role of experience in knowledge, whether knowledge of the present and the nearby gives us reasons for beliefs about the future, the past, or about events far away, and related issues. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5305:

Main Themes in the Philosophy of Modern Science and Technology

Problems, literature, and schools in the philosophy of science and technology. 5305: explanation and confirmation; 5306: theory change.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHIL 3505

Corequisite(s):

PHIL 5306 (STS 5306):

Main Themes in the Philosophy of Modern Science and Technology

Problems, literature, and schools in the philosophy of science and technology. 5305: explanation and confirmation; 5306: theory change.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5324:

Metaethics

A systematic examination of metaethics, the branch of philosophical ethics that addresses questions about the nature of ethical discourse and its objects. Investigation of such issues as the meaning of ethical terms and judgments, the nature and grounds of ethical truth, the possibility of ethical knowledge, the rationality of ethical behavior, and the relations between ethical and scientific inquiry. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5344:

History of Ethics

Examination of the work of selected figures representative of important positions in the history of ethical theory from the Classical Age to the modern period.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5505:

Symbolic Logic

Modern deductive symbolic logic and its metatheory. 5505: Development of a system of first order logic. Truth functional sentential logic, monadic predicate calculus with identity. Proof techniques and translation between natural and artificial languages. 5506: Logical metatheory: consistency, completeness, and decidability of logical systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5506:

Symbolic Logic

Modern deductive symbolic logic and its metatheory. 5505: Development of a system of first order logic. Truth functional sentential logic, monadic predicate calculus with identity. Proof techniques and translation between natural and artificial languages. 5506: Logical metatheory: consistency, completeness, and decidability of logical systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHIL 5604G:

Intermediate Pilosophy of Biology

This course is designed primarily for philosophy students with a strong interest in biology or biology students with philosophical interests. Topics

vary from year to year, but include the changing character of biology as a science, the special character of biological explanations and methods, and the place and value of reduction (e.g., of Mendelian to molecular genetics) in biology. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHIL 5614G:
Intermediate Philosophy of Science
An examination of the structure and methodology of science as well as key concepts such as explanation, confirmation, realism, and instrumentalism. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHIL 5904:
Project And Report
Only for students pursuing a Master of Arts degree with a non-thesis option. Variable credit course.
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

PHIL 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

PHIL 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHIL 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

PHIL 6014:
Special Topics in Philosophy
Close examination of a discipline, topic, or group of questions from a major philosophical tradition. Such areas as philosophy of language, philosophy of logic, and philosophy of mathematics, and such issues as causation, the nature of space and time, mental representation, logical positivism, and the linguistic turn will be examined. May be repeated for credit, with permission and different content, for a maximum of 12 hours. Completion of at least one of the philosophy M.A. core courses required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHIL 6204:
Advanced Topics in the History of Philosophy
Intensive study of a particular figure, school, or group in the history of philosophy, in cultural and theoretical context, such as Socrates in the Athenian polis, Stoicism in the Hellenistic age, or Hume and the Scottish Enlightenment. May be repeated for credit, with permission and different content, for a maximum of 12 hours. Completion of at least one of the philosophy M.A. core courses required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHIL 6224 (ASPT 6224):
Distributive Justice

Influential contemporary theories of distributive justice. Social, political, ethical, and cultural dimensions of distributive questions. Utilitarianism, liberalism, libertarianism, pluralism, multiculturalism, autonomy, rights, needs, (global) egalitarianism, and (global) poverty. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHIL 6324:

Advanced Topics in Ethics and Political Philosophy

A seminar closely examining a topic or group of topics in moral, social, or political theory. Such issues as the foundations of ethics, practical reason, the concept of virtue, political obligation, the bounds of moral and political community, paternalism, liberty, and privacy will be explored. Views considered may include moral realism and antirealism, contractarianism, egalitarianism, libertarianism, and communitarianism. May be repeated for credit, with permission and different content, for a maximum of 12 hours.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PHIL 5334 OR PHIL 5344
Corequisite(s):

PHIL 6334:

Advanced Topics in Philosophy of Science

Variable topics in advanced philosophy of science, including major theories of scientific explanation and their criticisms; philosophical foundations of statistics; naturalized philosophy of science. May be repeated for credit, with permission and different content, for a maximum of 12 hours.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHYSICS

Mark Pitt, Chair

Professors: Nahum Arav; Edwin Barnes; Sophia Economou; James Heflin; Jean Heremans; Patrick Huber; Giti Khodaparast; Jonathan Link; Camillo Mariani; Djordje Minic; Pendleton Montague; Seong Mun; Kyungwha Park; Leo Piilonen; Mark Pitt; Michel Pleimling; Vito Scarola; Eric Sharpe; John Simonetti; Tatsu Takeuchi; Uwe Tauber; Robert Vogelaar;

Associate Professors: Lara Anderson; Shengfeng Cheng; Satoru Emori; James Gray; Shunsaku Horiuchi; Vinh Nguyen; Thomas O'Donnell; Hans Robinson; Ian Shoemaker; Victoria Soghomonian;

Assistant Professors: Christopher Ashall; Rana Ashkar; Marie Boer; Chun Jun Cao; Cihan Kaplan; Tianci Zhou;

Roger Moore and Mojdeh Khatam-Moore Faculty Fellow: Patrick Huber;

L.C. Hassinger Faculty Fellow in Nanoscience: Giti Khodaparast;

Alumni Distinguished Professor: Leo Piilonen;

Adjunct Faculty: Levon Asryan; Zheng Chang; Louis Guido; Yi-Gao Liang; Ganapati Myneni; Alexey Onufriev; Mark Paul; Chenggang Tao; Zoltan Toroczkai;

Research Assistant Professors: Kenneth Wong;

William E. Hassinger, Jr., Senior Faculty Fellow in Physics: Sophia Economou;

Collegiate Assistant Professors: Danielle Lucero;

Graduate Contact: gradphys@vt.edu

Graduate Program Coordinator: bewilki2@vt.edu

Graduate Site: https://www.phys.vt.edu/Graduate/GraduateProgram.html

Student Handbook:
https://www.phys.vt.edu/content/dam/phys_vt_edu/graduateprogramdocuments/GraduateHandbook_2020.pdf

The Department of Physics offers program coursework and research leading to M.S. (thesis optional) and Ph.D. degrees. Details about the M.S. and Ph.D. degree options can be found in our graduate program policies document available at https://www.phys.vt.edu/Graduate/GraduateProgram.html The Department has internationally recognized excellence in experimental and/or theoretical aspects of astronomical, biological, condensed matter, nuclear, and particle physics. This research is supported by collaborations with researchers across Virginia Tech and at outside institutions of higher learning. Please visit the Department at https://www.phys.vt.edu/Research.html/ for more information.

SPECIAL FACILITIES

Experimental laboratories within the Department of Physics include facilities employing Raman scattering, far-infrared to near-ultraviolet spectroscopy, conventional and superconducting magnets, thin-film electron scattering, susceptometry, sol-gel studies, laser holography and spatial filtering, and pulsed laser nonlinear optical measurements such as harmonic generation and degenerate four-wave mixing, and clean-room. Other techniques and materials are available via collaborative programs with the Departments of Chemistry, Chemical Engineering, and Materials Science. Facilities are maintained in the Department of Physics to prepare experiments and analyze data collected by the radio astronomy and elementary particle groups which are currently working at national and international research centers, including FermiLab (FNAL, Illinois), Brookhaven National Laboratory (BNL, New York), Thomas

Jefferson National Accelerator Facility (TJNAF, Virginia), Oak Ridge National Laboratory (ORNL, Tennessee), Laboratori Nazionali del Gran Sasso (LNGS, Italy), Kou Enerugii Kasokukikenkyuukikou (KEK, Japan), Los Alamos National Laboratory (LANL, New Mexico), Kimballton underground science and engineering facility (Virginia), and National Radio Astronomy Observatory (NRAO, including the VLA and VLBA). Housed in the department is the university's Center for Neutrino Physics (CNP), as well as the Center for Soft Matter and Biological Physics. Virginia Tech university computing offers multiple high-performance computing systems. The Physics department has two dedicated clusters and a distributed collection of about 200 limited-availability nodes, all running Linux. Access to supercomputers is available through national and international networks. The Physics department operates a professional machine shop, a computer shop, and a student shop.

Physics Facilities

The faculty in Virginia Tech's Physics Department conduct research in astronomical, mathematical, medical, nuclear, elementary particle, and condensed-matter physics. Medical and neuroscience research is conducted at sites in Arlington and Roanoke, Virginia. Much of the research activity in astronomy and experimental nuclear and particle physics utilizes off-campus facilities, while most of the instrumentation and data analysis are performed on-campus. These facilities include Brookhaven National Laboratory, Daya Bay, Fermilab, KEK, LANL, ORNL, TJNAF, NRAO, Gran Sasso, and the nearby Kimballton Underground Research Facility (KURF). Telescopes used by the astronomy group include the Hubble Space Telescope, the Very Large Telescope, the Chandra X-ray satellite, the Spitzer IR satellite, and the XMM-Newton X-ray satellite. Experimental facilities in condensed-matter physics include low-temperature facilities and variable-temperature high-magnetic-field magneto-transport systems, low-temperature optical systems, pulsed near- and mid-infrared lasers, visible-ultraviolet lasers, spectrometers, confocal microscopy and related optical characterization facilities, nanofabrication systems, thin-film materials deposition systems, materials synthesis, room-temperature and low-temperature scanning tunneling microscopy, and various other microscopy systems. More analytical and nanofabrication systems (e.g., X-ray, Auger, TEM, AFM, SIMS, SQUID, and FIB) are housed in on-campus facilities. Research is also performed off-campus, for example, at the National High Magnetic Field Laboratory.Housed in Robeson Hall is the University's Center for Neutrino Physics (CNP). Many theorists are members of the University Center for Statistical Mechanics, Mathematical Physics, and Theoretical Chemistry, composed of faculty from the Departments of Chemistry, Physics, and Mathematics.The Department of Physics is also home to the Center for Soft Matter and Biophysics at Virginia Tech. This interdisciplinary research Center was established in February 2016, and is administered by the Department of Physics in the College of Science. Its mission is to advance the rapidly growing research areas of soft matter and biological physics. Special attention will be extended to how these developments can address many of the most significant problems currently facing society, for example effective drug design and delivery, next generation materials, programmable biology, and models for human disease.Virginia Tech University computing offers multiple high-performance computing systems. The Physics Department has two dedicated clusters and a distributed collection of about 200 limited-availability nodes, all running Linux. Access to supercomputers is available through national and international networks.The Physics Department operates a professional machine shop, a computer shop, and a student shop.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (90.0)

Degree requirements include courses, both required and elective, and a qualifying examination. There are two options, thesis and non-thesis, both of which require 32 credit hours of coursework. Thesis Master’s students must also write and defend a thesis, roughly comparable to a prelim exam.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (90.0)

Degree requirements include courses, both required and elective, dissertation research, and examination(s). The credit requirement for a Ph.D. is 92 hours, including a minimum of 60 hours of research and dissertation, plus 32 hours of coursework. Ph.D. students are required to attempt a qualifying exam by the end of their third semester, and a prelim exam by the end of their fifth semester.

GRADUATE COURSES (PHYS)

PHYS 5254G:

Advanced Quantum Info Tech

Quantum computing and other quantum information technologies. Differences between bit and qubit. Quantum logic gates, concept of entanglement, quantum teleportation, quantum cryptography and key distribution, quantum computing algorithms, including Deutsch-Jozsa algorithm, Grover’s search algorithm, Shor’s factoring algorithm. Basics

of public-key cryptosystems and number theory as needed to present Shor’s algorithm. Errors in a quantum computer and quantum error correction. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHYS 5264G:

Advanced Quantum Optics and Qubit Processors

Quantum optics and quantum bit (qubit) platforms for quantum technology applications. Qubit as physical system, quantum unitary evolution as quantum gate, quantum control using electromagnetic fields, Rabi oscillations, adiabatic theorem, density matrix, Liouville-von Neumann equation, decay and decoherence (T1 and T2), spin echo, Ramsey interferometry, coherent population trapping, entanglement, dynamical maps, electromagnetic field quantization, Jaynes-Cummings Hamiltonian, spontaneous emission, solid-state qubit platforms (spin qubits, superconducting qubits), atomic qubit platforms (trapped ions), color-centers in solids. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHYS 5354:

Classical Mechanics

Theory of classical Lagrangian and Hamiltonian mechanics of particles and rigid bodies, including canonical transformations and Hamilton-Jacobi theory. Consent required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHYS 5405:

Classical Electromagnetism

Classical theory of electromagnetism and its applications. 5405: Electrostatics and magnetostatics; Maxwells equations and electromagnetic waves; wave guides, apertures, and antennae. 5406: Special relativity and Lagrangian and Hamiltonian formulations; Lienard-Wiechert potentials, motion, radiation, and energy loss be charged particles; self-fields and radiative damping; magnetic monopoles and field theories. Consent required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): PHYS 5714

PHYS 5406:

Classical Electromagnetism

Classical theory of electromagnetism and its applications. 5405: Electrostatics and magnetostatics; Maxwells equations and electromagnetic waves; wave guides, apertures, and antennae. 5406: Special relativity and Lagrangian and Hamiltonian formulations; Lienard-Wiechert potentials, motion, radiation, and energy loss be charged particles; self-fields and radiative damping; magnetic monopoles and field theories. Consent required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PHYS 5405
Corequisite(s): PHYS 5714

PHYS 5455:

Quantum Mechanics

General principles of nonrelativistic quantum mechanics from the point of view of advanced dynamics, with applications to problems of atomic and nuclear structure. Consent required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHYS 5456:

Quantum Mechanics

General principles of nonrelativistic quantum mechanics from the point of view of advanced dynamics, with applications to problems of atomic and nuclear structure. Consent required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5455

Corequisite(s):

PHYS 5464:

Introduction to Quantum Field Theory

Quantum mechanics in the Schrodinger, Heisenberg, and Interaction pictures. Application of quantum mechanics to a lattice of interacting harmonic oscillators. The zero-lattice-spacing and infinite-space limits of the harmonic oscillator lattice. Quantization of bosonic and fermionic fields. Quantization of scalar, spinor, and vector fields. Gauge theories. Spontaneous symmetry breaking, Goldstone bosons, and the Higgs mechanism. Applications to particle physics and condensed matter physics. Calculation of cross sections and decay rates at the tree level.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5354, PHYS 5406, PHYS 5456

Corequisite(s):

PHYS 5504:

Nuclear and Particle Physics

Properties of nuclei, two-nucleon systems, nuclear force, nuclear models, nuclear reactions, alpha and beta decay, and fission. Relativistic kinematics, invariance principles, quantum numbers, strange particles, weak interactions, formation and production reactions, and symmetries. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5514G:

Advanced Introduction to Nuclear Physics

Nuclear properties and nuclear interactions. Nuclear reactions and radioactive decays, including alpha, beta and gamma decays. Theoretical models of the nucleus and their interpretations. Experimental methods in nuclear physics. Applications, including nuclear power production. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5555:

Solid-State Physics

Solidity, crystal structure, k-space, quantum mechanics of covalent bonding, phonon excitations, thermal energy, the nearly-free-electron approximation, Bloch electrons, E(k) energy bands in semiconductors and metals, density of states, optical properties of solids, donors and acceptors in semiconductors, excitons, plasmons, polaritons, electrical properties, magnetic materials, the percolation model and phase transitions, metal-insulator transitions, and amorphous solids. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5556:

Solid-State Physics

Solidity, crystal structure, k-space, quantum mechanics of covalent bonding, phonon excitations, thermal energy, the nearly-free-electron approximation, Bloch electrons, E(k) energy bands in semiconductors and metals, density of states, optical properties of solids, donors and acceptors in semiconductors, excitons, plasmons, polaritons, electrical properties, magnetic materials, the percolation model and phase transitions, metal-insulator transitions, and amorphous solids. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5564G:

Advanced Polymer Physics

Introduction to the field of polymer physics. Statistical descriptions of polymers based on Brownian motion and random walk models. Conformation of single chains. Thermodynamics of polymer mixtures, solutions, and melts. Properties of polymer networks. Polymer dynamics in both melt and solution states. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5574G:

Intermediate Nanotechnology

Methods of controlling matter on the nanometer length scale and the applications thereof. Nanolithography, self-assembly, and scanned probe microscopy; nanomaterials including fullerenes, carbon nanotubes, and quantum dots; nanoscale and molecular electronics; nanoelectromechanical systems; nanoscale optoelectronics; and nanobiotechnology. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5614G:

Intermediate Optics

Fundamentals of the ray, wave and quantum models of light, and topics in modern optics with contemporary applications. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5634G:

Advanced Modern Classical Physics

Geometric formulation of classical physics. Applications in relativity, optics, elasticity, fluid mechanics, plasma physics. Real-world examples from fundamental, experimental, and applied physics. Quantum roots of and quantum techniques in classical physics. Geometrical connections between classical mechanics, optics, and quantum physics. Problems in and connections between elasticity, fluid dynamics, magnetohydrodynamics, and plasma physics. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5654G:

Advanced Modern Cosmology

Survey of our current understanding of the origin, evolution, and fate of the Universe. Observational evidence behind the idea of the hot Big Bang, including the linear velocity-distance law, the existence of the cosmic microwave background, and the arguments for dark matter. Physics of a dynamic, expanding Universe via the Friedmann-Lemaitre-Robertson-Walker metric. Physical principles to determine the conditions in the early Universe, introducing the idea of inflation. Mechanisms driving the origin and evolution of galaxies and large-scale structures.

Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5664G:

Advanced Astroparticle Physics

Observations of high-energy photons, cosmic rays, and neutrinos. Energy-loss interactions in astrophysical environments. Propagation of cosmic particles and ultra-high energy cosmic rays. Origins of cosmic rays. Astrophysical neutrinos and neutrino oscillations. Stellar evolution and evolution into supernova explosions. Mechanisms of astrophysical particle acceleration. Multi-messenger astronomy. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5674G:

Intermediate General Relativity

Methods and applications of Einsteins general theory of relativity. Space and time and gravity in Newtonian physics; special theory of relativity; gravity as geometry of curved spacetime; black holes; cosmology; Einsteins gravitational field equations; gravitational waves and relativistic stars. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5705:

Statistical Mechanics

Theory of classical and quantum statistical mechanics. Derivation of thermodynamics. 5705: ensembles, fluctuations and ideal gas systems. 5706: modern developments and advanced topics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): , PHYS 5456

Corequisite(s):

PHYS 5706:

Statistical Mechanics

Theory of classical and quantum statistical mechanics. Derivation of thermodynamics. 5705: ensembles, fluctuations and ideal gas systems. 5706: modern developments and advanced topics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5456, PHYS 5705

Corequisite(s):

PHYS 5714:

Methods of Theoretical Physics

Selected topics in mathematical physics. Review of analytic function theory. Matrices, spectral theory of operators in Hilbert Space with applications to quantum mechanics. Solution of partial differential equations of mathematical physics, boundary-value problems, and special functions. Distribution theory and Greens functions. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5714G:

Biophysics

Selected topics from the general area of biomechanics, bioelectricity, radiation biophysics, molecular biophysics, and thermodynamics and transport in biological systems. Emphasis on the physical aspects of biological phenomena and biophysical measurement techniques and instrumentation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5724G:

Advanced Soft Matter Physics

Physical characteristics of various soft matter systems including liquids, liquid crystals, polymers, colloids, surfactants, granular materials, and biological soft materials. Van der Waals and electrostatic interactions in the context of soft matter. Descriptions of soft matter phases, phase diagrams, phase separation, and phase transitions. Theories of self-assembly and self-organization. Problems in and connections between elasticity, viscoelasticity, and mechanics of fluids including capillarity and wetting. Model of random walk and its applications to colloidal systems. Applications of variational methods in soft matter. Computer simulation methods in soft matter. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5794:

Computational Physics

Survey of computational methods in physics. Applications of Fourier analysis, curve fitting, solving differential equations, solving integral equations, Monte Carlo simulations, symbolic mathematics, and graphic simulations in mechanics, electromagnetism, nuclear physics, atomic physics, molecular physics, and condensed matter physics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 4455

Corequisite(s):

PHYS 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PHYS 5944:

Seminar

May be repeated one time with different content for a maximum of 2 credits.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

PHYS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PHYS 6455:

Advanced Quantum Theory

Classical field theory; Noethers theorem and symmetries; second quantization and many-body formalism; free quantum Klein-Gordon, Dirac, and Maxwell fields; and interacting fields, S-matrix and covariant perturbation theory. Feynman diagrams; quantum electrodynamics; renormalization; path-integral formulation; non-Abelian gauge theories; and elements of electro-weak theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5354, PHYS 5406, PHYS 5456

Corequisite(s):

PHYS 6456:

Advanced Quantum Theory

Classical field theory; Noethers theorem and symmetries; second quantization and many-body formalism; free quantum Klein-Gordon, Dirac, and Maxwell fields; and interacting fields, S-matrix and covariant perturbation theory. Feynman diagrams; quantum electrodynamics; renormalization; path-integral formulation; non-Abelian guage theories; and elements of electro-weak theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5354, PHYS 5406, PHYS 5456, PHYS 6455

Corequisite(s):

PHYS 6555:

Advanced Solid-State Physics

Applications of field-theory techniques to many-body aspects of solid-state physics. 6555: Green functions, Feynman diagrams, lattice Hamiltonian, neutron scattering, electron gas, Fermi-liquid theory, and linear-response theory. 6556: Electron-phonon interaction in metals and semiconductors, polarons, optical properties, excitons, superconductivity, and excitations in magnetic materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5456, PHYS 5555

Corequisite(s):

PHYS 6556:

Advanced Solid-State Physics

Applications of field-theory techniques to many-body aspects of solid-state physics. 6555: Green functions, Feynman diagrams, lattice Hamiltonian, neutron scattering, electron gas, Fermi-liquid theory, and linear-response theory. 6556: Electron-phonon interaction in metals and semiconductors, polarons, optical properties, excitons, superconductivity, and excitations in magnetic materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5456, PHYS 5555

Corequisite(s):

PHYS 6676:

General Relativity and Cosmology

6675: Differential geometry; equivalence principle; general theory of relativity; classical tests; post-Newtonian approximation; special solutions. 6676: Black holes; observational basis of cosmology; relativistic model universes; nucleosynthesis; cosmoic background radiation; dark matter; inflation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 5354, PHYS 5406

Corequisite(s):

PHYS 6714:

Selected Topics in Theoretical Physics

Topics of current interest in theoretical physics as announced in Timetable. May be repeated for credit with permission. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 6725:

Elementary Particle Physics

Symmetry principles, quark model, scattering-theory and particle-theory processes, weak interactions, quantum chromodynamics, spontaneous symmetry breaking, and unified field theories. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): PHYS 6455, PHYS 6456

PHYS 6726:

Elementary Particle Physics

Symmetry principles, quark model, scattering-theory and particle-theory processes, weak interactions, quantum chromodynamics, spontaneous symmetry breaking, and unified field theories. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHYS 6725

Corequisite(s): PHYS 6455, PHYS 6456

PHYS 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHYS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PLANNING, GOVERNANCE, AND GLOBALIZATION

Timothy Luke, Interim Head

Emeriti Faculty: James Bohland;

Professors: Ariel Ahram; Ralph Buehler; Ralph Hall; Ilja Luciak; Timothy Luke; Joel Peters; Thomas Sanchez; Max Stephenson; Gerard Toal; Edward Weisband;

Associate Professors: David Bieri; Margaret Cowell; Giselle Datz; Steven Hankey; Shalini Misra; Todd Schenk; Ioannis Stivachtis; Diane Zahm; Yang Zhang;

Assistant Professors: Nataliya Brantly; Chad Levinson; Theodore Lim; Paroma

Wagle;

University Distinguished Professor: Timothy Luke;

Edward S. Diggs Professor in the Social Studies: Edward Weisband;

School of Public & International Affairs: spia@vt.edu

Planning, Governance, & Globalization: http://www.spia.vt.edu/phd-pgg

Student Handbook: http://www.spia.vt.edu/pgg/handbook

The Ph.D. program in Planning, Governance and Globalization (PGG) is one of two Ph.D. programs available in the School of Public and International Affairs (SPIA), the other being the Ph.D. in Public Administration. The Ph.D. in PGG attracts students with widely differing backgrounds and interests. In order to accommodate this diversity, curriculum requirements are defined in two tracks with several thematic areas. These are: Urban & Environmental Design & Planning TrackThematic Areas: Metropolitan Development Community & Economic Development Planning International Development Planning Environmental Planning & Sustainability Landscape Planning & Landscape Analysis Transportation Planning Physical Planning & Urban Design Governance & Globalization TrackThematic Areas: Governance: Institutions & Civil Society Globalization: Identities, Security, & Economies

SPECIAL FACILITIES

SPIA is associated with one university-wide center (VCHR) and one SPIA institute (IPG). The Institute for Policy and Governance (IPG) facilitates and provides leadership in Virginia Tech's outreach mission to organizations in the Commonwealth's public and non-profit sectors, as well as national and international agencies. The Institute works with existing public service, extension, and outreach programs to respond effectively to existing demands on their services. The Institute identifies new opportunities for outreach, extension, and supporting research pertaining to administration, management, planning, and policy analysis related to public and non-profit organizations.The Virginia Center for Housing Research (VCHR) has a mission to serve as "an interdisciplinary study, research, and information resource on housing for the Commonwealth of Virginia." Consulting on housing issues with the General Assembly, federal, state and local agencies, nonprofit organizations, private industry, and other colleges and universities, the Center also plays a role in the state's housing policy and research network. The Center provides data services related to housing to local and state governments, nonprofit organizations, and for-profit businesses.The Land Design and Simulation Lab conducts studies of the environmental impacts of proposed land alternations and proposes measures that can be implemented to mitigate adverse impacts.

Architecture Annex - Blacksburg

The Architecture Annex is the main administrative building for the School of Public and International Affairs and houses the Government and International Affairs and Urban Affairs and Planning programs of the College of Architecture and Urban Studies. The Architecture Annex is the Blacksburg home for the PGG program and is located at 140 Otey Street, NW.

Virginia Tech Research Center - Arlington

The PGG Program in Arlington is housed in the Virginia Tech Research Center — Arlington.   Located at 900 N. Glebe Road, The Virginia Tech Research Center — Arlington is a highly visible state-of-the-art facility designed to further the university's mission to expand its research portfolio in the greater Washington, D.C., metro area. The region offers great opportunities for partnerships with corporate research entities and close proximity to government agencies and other public and private-sector organizations. The building is located in the vibrant Ballston district of Arlington, a short distance from many of the leading science and research agencies of the federal government and many high-technology companies.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Each doctoral student must complete a minimum of 90 semester hours of graduate study and a dissertation. All students are required to fulfill the requirements for their track or specialization and those of the Graduate School. The curriculum of this doctoral program will follow a flexible research-based program by requiring a small core of courses and by offering two major tracks, as well as thematic areas under each track. By the end of their first 24 credit hours in the program all students will be expected to have:(1) developed a plan of study;(2) selected a faculty advisory committee of a minimum four members; and(3) completed a "qualifying examination" by their faculty advisory committee. The qualifying examination ensures that the student is making satisfactory progress toward the degree.By the time students complete the preliminary exam, they must have met the Graduate School's Ethics Requirement. Meeting this mandatory requirement ordinarily will be satisfied by taking SPIA 6014 (Pedagogy and Learning) or in extraordinary circumstances, when SPIA 6014 cannot be taught, by other courses agreed to by the student's advisory committee.Governance & Globalization Track RequirementsThe following courses can be used to meet the 12-hour, 4-course core requirements. Accordingly, all students would take 12 credit hours of common core courses: Pedagogy (3cr): SPIA 6014 or approved substitution. Theory (3cr): GIA/PSCI 6114: Critical Geopolitics or equiv. approved by advisor. Methods (6cr): GIA/PSCI 5115: Research Methods (3 hrs) and one (or more) of the following: GIA 5464: Qualitative Methods in Global Studies (3hrs) GIA/PSCI/UAP 5504: Discourse Analysis (3hrs) UAP 5224: Planning Methods and Technologies (Statistics) (3hrs) Also required: Research (30cr minimum): GIA 7994: Research and Dissertation. Urban & Environmental Design & Planning Track RequirementsStudents must have preparation in the diverse theoretical literatures that define the field and in both quantitative/analytic and qualitative/field research methods, as well as training in research design. Accordingly, all students would take 12 credit hours of common core courses: Pedagogy (3cr): SPIA 6014 or approved substitution. Theory (3cr): SPIA 6104: Planning Theory Seminar or approved substitution. (Take before Qualifying Exam). This seminar traces the epistemology of major contemporary theories of planning so as to situate the activity of modern planning in historical and intellectual contexts. Methods (6cr): UAP 5484: Research Methodology (3cr), and UAP 5494 (Advanced Quantitative Techniques (3cr), or equivalents. Also required: Research (30cr minimum): UAP 7994: Research and Dissertation. Students pursuing thematic areas Landscape/Environmental Planning and Landscape Analysis will be required to complete two additional core courses, although these may be waived if students have already taken equivalent courses successfully. LAR 5314 -Contemporary Research Topics (3 credits) LAR 5344 - Scholarship of Place (3 credits) Following successful completion of the "qualifying evaluation" students continue to take coursework as outlined in their plans of study. At the completion of coursework, students will undertake the "preliminary examination", a formal assessment of each student's preparedness to pursue advanced graduate research. Within 60 days of passage of the preliminary examination, students must defend the dissertation proposal before his or her faculty advisory committee. Upon completion of the dissertation, the student must defend it before the committee. Graduate School policies and guidelines determine all other degree requirements.

PLANT PATHOLOGY, PHYSIOLOGY, AND WEED SCIENCE

Michael Evans, Head

Emeriti Faculty: Elizabeth Grabau; Ruth Grene; Edward Hagood; Mary Hansen; Sue Tolin;

Professors: Shawn Askew; Maria Balota; Jeffrey Derr; Jonathan Eisenback; Chuanxue Hong; Charles Johnson; David Langston; John McDowell; Steven Rideout; David Schmale; Boris Vinatzer; James Westwood; Keith Yoder;

Associate Professors: Jacob Barney; Antonius Baudoin; Eva Colla'kova'; Michael Flessner; David Haak; John Jelesko; David McCall; Mizuho Nita; Guillaume Pilot; Xiaofeng Wang;

Gary Endowed Professorship in Horticulture: Chuanxue Hong;

Graduate Contact: spesgradinfo@vt.edu

Graduate Site: http://www.spes.vt.edu/

As a graduate program within the School of Plant and Environmental Sciences (SPES), the core mission of the Plant Pathology, Physiology and Weed Science (PPWS) program is to optimize plant productivity and quality by limiting the impact of biotic and abiotic stresses on the profitability of crops and other plant enterprises, as well as the impact of these stresses on natural and agricultural ecosystems. The program offers a Ph.D. degree in several areas of concentration within SPES: plant pathology, the study of diseases, plant pathogens and their management; plant physiology, the study of plant function, growth and development and response to environmental stresses; weed science, the study of weed biology, ecology and management; and molecular plant sciences, basic biology, biochemistry and genetics of plant and plant pathogen systems. At the master's level, PPWS students participate in the M.S. program in Life Sciences, which also allows flexibility among the different options. For the M.S., students apply to the MSLFS degree type and select PPWS as the program.

SPECIAL FACILITIES

PPWS facilities are located on-campus (Blacksburg) and at the Virginia Agricultural and Extension Centers (ARECs), including: Smyth Hall (main offices), BlacksburgPrice Hall, BlacksburgLatham Hall, BlacksburgGlade Road Complex, BlacksburgKentland Farm, BlacksburgTidewater AREC, SuffolkEastern Shore AREC, PainterSo. Piedmont AREC, BlackstoneAlson H. Smith AREC, WinchesterHampton Rds. AREC, Virginia Beach

Latham Hall

Faculty in the School of Plant and Environmental Sciences are working in Latham Hall to improve human health and nutrition, sustain the environment, and develop resilient and productive cropping systems. Extensive resources for breeding, genetics, physiology, biochemistry, molecular biology, microbiology, plant pathology, microscopy, metabolomics, genomics, tissue culture, plant transgenesis, bioinformatics, and controlled environment experiments are available for graduate research.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal (150.0), Quantitative (150.0), Analytical (4.0)

Masters degree: PPWS offers the M.S. degree in any of the departmental concentrations. M.S. students meet the core requirements of the M.S. in the Life Sciences program and choose electives for the plan of study in consultation with a three-person advisory committee. The M.S. requires 30 credit hours, including at least 6 research credits for the thesis option; a non-thesis option is also available. M.S. students are required to present a research seminar and a final defense seminar and participate in one teaching activity. All M.S. students meet annually with the advisory committee for an annual progress evaluation.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal (150.0), Quantitative (150.0), Analytical (4.0)

Doctoral degree: The Ph.D. degree requires 21 credit hours of coursework and a total of 90 credit hours for graduation. Ph.D. students develop a plan of study in consultation with a four- or five-person advisory committee in the third semester and take both written and oral preliminary examination in the fourth semester of graduate studies. Ph.D. students present two departmental seminars, a final defense seminar and participate in two graduate teaching activities. All Ph.D. students meet annually with the advisory committee for an annual progress evaluation.

GRADUATE COURSES (PPWS)

PPWS 5034:

Clinic and Field Experience

Student interns will participate in either a plant disease or a weed oriented clinic experience. Student interns will learn to diagnose and make recommendations for control of plant diseases from specimens received by the Plant Disease Clinic, or will learn to identify and make recommendations for control of weeds received by the Weed Clinic. Each of the two options within the course may be taken once for credit.

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab

Instruction Type(s): Lab

Prerequisite(s): , PPWS 4754

Corequisite(s):

PPWS 5054:

Plant Pathogenic Agents

Biology of plant pathogenic fungi, prokaryotes, viruses, and nematodes: morphology, taxonomy, ecology, plant-pathogen interactions, symptomatology, and selected aspects of management. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5064:

Seminar in Molecular Cell Biology and Biotechnology

Review and discussion of current problems and literature in molecular cell biology and biotechnology by students, VPI&SU faculty and outside speakers. Students give formal presentations of research results or current literature. May be taken on pass-fail basis. Students enrolled in the MCBB Ph.D. option will be required to give one formal presentation on an A-F basis.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5154:

Plant Problem Diagnosis

Plant problem diagnosis in the laboratory and field, including recognition of disease, insect and abiotic (nonliving) problems, as well as the major groups of plant pathogens of a variety of regionally important horticultural and agronomic crops. General management options for pests and pathogens. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5204:

Principles of Plant Disease Management

Methods of plant disease management, and theories and effectiveness of their application. Discussion based on epidemiological principles. Methods include: cultural practices, resistance, chemical, and biological control. Laboratory 5214 supplements this course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   PPWS 3104

Corequisite(s):

PPWS 5214:

Diseases of Crop Plants

Symptoms, pathogen morphology, etiology, epidemiology, and practical control principles for important diseases of grains, oilseeds, legumes, forages, vegetables, fruits, ornamentals, and turf. Two semesters of college biology and one course in general plant pathology or equivalent exposure required. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   PPWS 3104

Corequisite(s): null null

PPWS 5234:

Applied Statistics for Plant and Environmental Sciences

Experimental design, data management, practical implementation of appropriate linear modeling statistical methods for plant, agricultural, and environmental research data. Emphasis on parametric methods, with some non-parametric analyses. Design lab/studio environment using a commercial standalone statistical program to analyze provided agricultural/environmental data sets as well as student's original research data. Design Lab/Studio.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Instruction Type(s): Lab, Lecture, VB, Online Lecture

Prerequisite(s): STAT 5615

Corequisite(s):

PPWS 5314 (GBCB 5314):

Biological Paradigms for Bioinformatics

This course is an intensive introduction to the central paradigms of molecular cell biology for bioinformatics. Material from cell molecular biology, and genetics will be presented, and placed in a genomics context. The course prepares students in mathematical disciplines to interact in teams in the pursuit of bioinformatics research. Pre: Senior or graduate standing in mathematically-based disciplines such as computer science, statistics, mathematics or engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5344 (BCHM 5344):

Molecular Biology for the Life Sciences

A multi-disciplinary treatment of gene organization and expression in animal and plant systems. Emphasis on the applications of molecular biology to current problems in applied biology and biotechnology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BCHM 4116 OR BCHM 5124

Corequisite(s):

PPWS 5454:

Plant Disease Physiology and Development

Principles and concepts of infection and colonization of plants. Role of hosts and pathogens physiology and biochemistry in disease susceptibility and resistance, recognition, and disease specificity.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5534:

Advanced Plant Physiology and Metabolism II

Presentation of the current understanding of metabolic and functional relationships among primary and secondary metabolites and storage products and their impact on the whole plant. Biosynthesis of phytohormones. Mechanisms controlling responses to phytohormones including: impact on carbon/nitrogen partitioning, senescence, development of higher plant structures such as vascular tissue and flowers. Pre: undergraduate major in Biology or related discipline.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5604G:

Adv Biological Invasions

Causes, consequences, and epidemiology of invasive plants animals, and microbes. Conceptual, mechanistic, societal, and political components of invasive species from Darwin to modern day; invasion process from introduction to ecological or economic impact. Taxonomy, management, and risk assessment, within a policy context. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture, Online Lecture

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5704:

Weed Science and Management

Biological and ecological principles that influence persistence and spread of weeds. Weed genetics and the dynamics of plant species and communities, with emphasis on invasive species. Characteristics of herbicide action and metabolism that influence selectivity, resistance, and fate. Genetic engineering of herbicide resistant crops. Analysis of weed control programs for specific crops Pre: Two semesters of college

biology and chemistry or two years experience in agricultural production, industry, or policy. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PPWS 5714:
Molecular Biology for Applied Plant Sciences
Fundamental principles of molecular biology and genomics in applied plant production disciplines. Applications of molecular biology to research through problem-based, hands- on methods in plant pathology and weed control. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Instruction Type(s): Lab, Lecture, VB, Online Lecture
Prerequisite(s):
Corequisite(s):

PPWS 5894:
Final Exam (Non-Thesis)
For students pursuing a non-thesis Masters degree, who have completed all other course work.
Credit Hour(s): 3
Lecture Hour(s): 0
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PPWS 5904:
Project and Report
For students pursuing a non-thesis Masters degree. Projects may involve guided research or an internship.
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

PPWS 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study
Instruction Type(s): Independent Study
Prerequisite(s):
Corequisite(s):

PPWS 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PPWS 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

PPWS 6004:
Advanced Topics in Plant Pathology, Physiology, and Weed Science
In depth presentations and discussions on selected advanced topics in plant pathology, physiology, and weed science. May be repeated.
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PPWS 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PPWS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

POLITICAL SCIENCE

Timothy Luke, Chair

Emeriti Faculty: Richard Rich; Richard Shingles; Charles Taylor; Charles Walcott;

Professors: Francois Debrix; Karen Hult; Farida Jalalzai; Bettina Koch; Ilja Luciak; Timothy Luke; Michael Moehler; Ioannis Stivachtis; Edward Weisband; Laura Zanotti;

Associate Professors: Clair Apodaca; Mauro Caraccioli; Priya Dixit; Laura Jensen; Deborah Milly; Wayne Moore; Scott Nelson; Besnik Pula; Patrick Roberts; Andrew Scerri;

Assistant Professors: Paul Avey; Binio Binev; Aaron Brantly; Cara Daggett; Lillian Frost; Bikrum Gill; Nicholas Goedert; Caitlin Jewitt; Karin Kitchens; Desiree Poets; Audrey Reeves; Clara Suong; Fabian Wendt;

University Distinguished Professor: Timothy Luke;

Edward S. Diggs Endowed Chair in the Social Sciences: Edward Weisband;

Center for Public Administration and Policy: Laura Jensen; Patrick Roberts;

Adjunct Faculty: Arnold Dupuy; Adam Newmark; Luke Plotica;

Collegiate Assistant Professors: Brandy Faulkner; Courtney Thomas;

General Contact: saharvey1@vt.edu

Graduate Site: https://liberalarts.vt.edu/academics/graduate-programs/masters-programs/master-of-arts-in-political-science.html

The Master of Arts in Political Science was established in 1969. Currently, the program enrolls 20 to 25 full-time students on campus each year and approximately 20 to 25 off-campus students in the Online Master of Arts in Political Science Program (OLMA/PSCI). This relatively small scale provides excellent opportunities for close student-faculty interaction in both the residential and online degree programs. The Master of Arts Program covers all sub-fields of the discipline, and it prepares students for careers in academe, government, non-profit and for-profit organizations. It is especially well suited for students who want to acquire sophisticated theoretical and analytical skills before either pursuing a doctoral degree in political science or entering careers in public or private research organizations. The usual course of study is four semesters of full-time graduate work. The first three semesters are used primarily for required foundation courses and elective coursework while the fourth is used to write a master's thesis. In recent years, M.A. students in political science have enrolled in this program from a wide variety of American colleges and universities. Students have also entered the M.A. program from a number of other countries including Argentina, Austria, Bolivia, Brazil, Canada, China, Colombia, England, France, Germany, Greece, India, Iran, Ireland, Israel, Mexico, Norway, Portugal, Romania, Scotland, South Korea, Sweden, Switzerland, and Turkey. Recent graduates have entered doctoral studies in Ph.D. programs at Arizona, Arizona State, California-Berkeley, California-Irvine, California-San Diego, Colorado State, Connecticut, Delaware, Denver, Duke, Florida International University, Florida State, Georgia, Illinois (Urbana-Champaign), Indiana, Iowa, Johns Hopkins University, Kentucky, London School of Economics, Massachusetts-Amherst, Maryland, Minnesota, Michigan State, Nebraska, North Carolina, Northeastern, Penn State, Pittsburgh, Purdue, Ohio State, Oregon, Oxford, Strathclyde, University of South Carolina, SUNY-Albany, SUNY-Stony Brook, Syracuse, Texas A&M, Texas-Austin, Washington University-St. Louis, Utah, Wisconsin, Virginia Tech, and Virginia. Other graduates have taken professional positions in government agencies, political parties, interest groups, research institutes and non-profits.

SPECIAL FACILITIES

504 Major Williams

Craig L. Brians Research Lab

The Craig L. Brians Research Lab is open to graduate students 24 hours a day. It contains several computers linked to the Internet and campus networks. A variety of research and word processing software is available for these machines. Knowledge of these resources combined with emphasis on quantitative and qualitative methods are assets to students who anticipate working in a public or private agency or at an educational institution. Students also have access to a wide variety of data sets through the University's membership in the Intercollegiate Consortium for Political and Social Research (ICPSR).

DEGREES OFFERED

MA Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (600.0), Writing (4.5)

iBT: (100.0), Writing (24.0)

GRE--Recommended

The degree requirements for the MA are 21 hours of coursework and 9 hours of Thesis and Research. Three classes are required: PSCI 5115-Research Methods I (3 cr.) PSCI 5116-Research Methods II (3 cr.) PSCI 5214-Contemporary Political Theory (3 cr.) 4 electives (12 cr.).

GRADUATE COURSES (PSCI)

PSCI 5104 (STS 5104) (SPIA 5104):

Policy Gateway: Policy and Decision Making in Scientific Domains

Key concepts in policy making, including policy analysis and decision making in complex social and technical settings. Policy process theories and evaluation tools. Concepts of governance including public values,

ethics, and variable impacts across communities. Relationships among public policy decision processes and science, technology, and engineering, including disciplinary norms. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5114 (ASPT 5114):
Critical Research Design
Analysis of challenges related to power and ethics in the design of political research. Special emphasis on research question formulation, case selection, identification of sources, and qualitative research methods. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5115 (GIA 5115):
Research Methods
The purposes, problems, and strategies of political science research, emphasizing concept and hypothesis formulation, operationalization, research design, data collection techniques, data processing, and multivariate data analysis.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5116 (GIA 5116):
Research Methods
The purposes, problems, and strategies of political science research, emphasizing concept and hypothesis formulation, operationalization, research design, data collection techniques, data processing, and multivariate data analysis.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5115, STAT 5654
Corequisite(s):

PSCI 5124 (STS 5124) (SPIA 5124):
Decision Making, Reflective Practice, and Engagement in STEM-H Domains
In-depth case-based exploration of roles of science, technology, engineering, and mathematics in policy-making. Application of theories, concepts and practices for policy decision-making, including stakeholder engagement, human behavior, and organizational development. Critical examination of ethics, and fostering of reflective practice. Implications of big data and modeling in decision-making. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5134 (SPIA 5134) (STAT 5134):
Tools and Approaches for Policy-Making in STEM-H Domains
Techniques for translating theory-driven, qualitative concepts into quantitative data-focused modeling to address policy problems. Quantitative and computational tools including statistical inference and hypothesis testing, system dynamics, and economic analysis. Modeling paradigms and common challenges in modeling. Modern data analytic practices, including good collection, storage and visualization techniques. Problem definitions and application to real-world policy-related problems and implementation in modern software packages. Understanding complexity. Critical evaluation of challenges and common pitfalls in quantitative modeling. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5154 (SPIA 5154) (STS 5154):
Science, Technology, and Engineering in Policy Seminar
Seminar for Science, Technology, and Engineering in Policy (STEP) program students. Presentation of research on the intersections of science, technology, engineering, math, and health (STEM-H), public policy, and ethics. Professional development. Research resources and tools. Project management and funding opportunities. Publishing standards and processes across disciplines. STEM-H and policy practitioner engagement. Multidisciplinary communication. May be repeated up to six times, as seminar and presentation topics will change

each semester. Pass/Fail only. Pre: Graduate standing.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5214 (GIA 5214):
Contemporary Political Theory
Selected topics in contemporary political theory, including different models of social science inquiry and the use of basic concepts like power, ideology, rationality, and the state in the study of politics.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5224 (GIA 5224):
Alternative Perspectives in Political Theory
Analysis of selected perspectives on politics including: rational choice theory, critical theory, neo-marxism, neo-conservatism, post-industrialism, and post-structuralism.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5234:
Women in Politics Across the Globe
Gendered constructs and practices shaping women’s incorporation in political institutions in global politics. Effects of women's inclusion on policy outcomes, perceptions of women in power, and patterns of governance. Research techniques (qualitative and quantitative) employed in contemporary studies of women in national level politics worldwide. Pre: Graduate standing. (3H, 3C).
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5254 (GIA 5254):
Global Conflicts
Examines theoretical issues in the study of global conflicts. Reviews theories of nationalism, states and territory as factors. Examines dynamics of contemporary conflicts from different regions of globe as case studies illustrating theoretical issues. Reviews role of leaders in conflict processes. Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5284 (GIA 5284):
Transnational Migration
Overview of the dynamics, policies, governance, and citizenship regimes associated with the phenomenon of transnational migration. The course will emphasize local, national, and supranational examples and comparisons to explore these themes. Graduate standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5314:
Legislative Branch
The legislative process in American state and federal governments including recruitment of members, organization and functioning of legislative systems, and relations with both constituents and other branches.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5324:
Executive Branch
The executive office and bureaucracy of American state and federal governments including recruitment, organization of executive branches, decision making, leadership styles, and relations with other branches.
Credit Hour(s): 3
Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5334:
Judicial Branch
The American judicial system including recruitment of personnel, uses of the courts, judicial policy, relations with other branches, judicial behavior, and the impact of court decisions.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5344:
Political Behavior
Approaches to the study of political behavior including political psychology, rational choice, biopolitics, socialization, communication, public opinion, and political participation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5354:
Public Policy Analysis
Approaches to policy analysis and program evaluation including the techniques appropriate to various stages of the policy process.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5364 (GIA 5364) (STS 5364):
Public Ecology
Examines policy developments and practices that move beyond the conceptual divisions and policy operations begun during the 1970s, which largely divided the more natural science- based environmental sciences from social science-based environmental based studies. Mixes the insights of life science, physical science, social science, applied humanities, and public policy into a cohesive conceptual and operational approach to environmental protection in the 21st century. Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5374 (GIA 5374):
Electronic Governance
Examines applications of information technology in government from the point of view of governments and citizens. Survey of the relationship between e-government e-democracy and of government management techniques. Explores problematic issues related to e-government, such as privacy, the digital divide, and information security.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5214, PSCI 5554 OR UAP 5564
Corequisite(s):

PSCI 5384 (WGS 5424):
Identity Migration and Place
Place-based identities and intersectional inequalities. Influence of these interrelated dimensions on the study of forced and voluntary migrations within and across national borders, and such discourses as home, belonging, nationhood, and citizenship.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): WGS 5114
Corequisite(s):

PSCI 5414 (GIA 5414):
Industrial Democracies
Political patterns and processes of development in selected democracies in Europe, North America, and Asia emphasizing the political problems of contemporary industrial societies and their likely evolution in a post-industrial era.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):
Corequisite(s):

PSCI 5424:
Communist and Post-communist Systems
Political processes and developmental trends in communist and post-communist systems in Russia and other CIS states, Eastern Europe, the Peoples Republic of China, and the Third World. Current economic, political, and social issues and their likely development.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5434 (GIA 5434):
Politics of Developing Areas
Political structures, economic growth, and cultural frameworks of developing nations in Asia, Africa, and Latin America emphasizing the political and economic challenges of industrial development in a global economy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5444 (GIA 5444):
International Politics
Theories of international organizations and relations among nations focusing on research in foreign policy formulation and implementation, international integration, conflict resolution, and global political economy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5454:
Advanced Topics in Information Technology and Public Policy
In-depth study and critical evaluation of selected complex issues related to information technology, society, governance, and public policy. Focused attention is given to theoretical and methodological foundations of the area of inquiry and to specific domains of policymaking and implementation. Topics will be selected from IT-related issues in such areas of concern as: cities, local communities, nonprofit organizations, governments, and global networks. May be repeated on a different topic. Must meet prerequisite or have permission of the instructor.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): UAP 5564
Corequisite(s):

PSCI 5464:
Critical Security Studies
Provides an overview of the critical study of security in world politics. Introduces alternative conceptualizations of security to the military-focused, state-centric security/strategic studies. Considers constructivist, post-structuralist and critical theoretic attempts to conceptualize the nature of security. Compares and contrasts these approaches with widely-accepted understandings of security in light of key debates in contemporary security studies.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PSCI 5444 OR GIA 5444
Corequisite(s):

PSCI 5474 (GIA 5474):
Global Governance
Examination of the norms, institutions and practices developed by the international community to address systemic global governance problems: genocide, failed states, transnational corruption, displaced persons, AIDS, poverty. Role of United States in World community examined. Power of international organizations versus states. Capacity problems of both. Future of United Nations and global governance considered. Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5484 (GIA 5484) (HIST 5484):
Contemporary American Foreign Policy
Covers U.S. foreign policy during the Cold War, the stalemate with the Soviet Union, armament and arms control, containment and deterrence,

detente and Reaganism, and the end of the Cold War. Briefly covers events from 1989 to the present. Designed for students with an interest in foreign policy and global affairs. Prereqs or instructors permission.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5214, PSCI 5444

Corequisite(s):

PSCI 5504 (UAP 5504) (GIA 5504):

Discourse Analysis

Examines the key theoretical sources and major practical applications of discourse analysis as a contemporary social science methodology. Origins, major variants, and critical uses of discourse analysis in cultural studies, semiotic methods, policy analysis, and organizational communication techniques also are considered. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5514 (GIA 5514):

Global Security

Security examined as an essentially contested concept. Traditional national security and emergent global security discourses and agendas explained. Security institutions and organizations analyzed. Questions of power, identity and representation examined as factors delimiting security conceptions, practices and agendas. Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5524:

U.S. Foreign Policy After September 11

Course offers a historical and analytical evaluation of U.S. foreign policy after this epochal change especially with regard to the war on terror, geopolitics in the Middle East, and relations with new global powers after the end of the Cold War.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5484

Corequisite(s):

PSCI 5554 (GIA 5554):

Culture, Politics and Society in Network Environments

Historical origins, institutional foundations, and theoretical interpretations of cultural, political, and social interaction through computer mediated communication are examined. Particular attention is given to new types of discourse, sources of power, and structures of society at all geographical levels in global computer and communications networks.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5564:

Women and Globalization

Feminist theoretical paradigms the analyze impacts of globalization on women and girls. Impacts of globalization on households and families. Relationship between globalizing processes and gender inequalities. Addresses feminist controversies and womens transnational resistance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5574 (UAP 5574):

Arts, Culture and Society

Considers the role of the arts in society, including architecture, music companies, or theater productions to heritage sites, science museums, and art galleries. Effective arts policy in revitalizing urban economies also examined. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5584 (UAP 5584) (GIA 5584):

Environmental Politics and Policy

Course provides a broad introduction to the key ideas, actors and

institutions related to environmental politics and policy in the United States, with some coverage of global issues. It is intended to provide students with basic interdisciplinary knowledge and an intellectual framework for understanding and thinking critically about environmental politics and policy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5614 (GIA 5614) (HIST 5544):
Understanding The Israeli Palestinian Conflict
Dynamics of the Israeli-Palestinian conflict. Critical issues that underlie the conflict and divide Israel and the Palestinians. Diplomatic efforts aimed at resolving the conflict. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5624 (GIA 5624):
Conflict Resolution and Peace Building
Comprehensive guide to contemporary conflict resolution. Strategies and approaches for mitigating and resolving conflict. Process of conflict transformation and reconciliation. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5644:
Womens Rights as Human Rights
International mechanisms for development and protection of womens human rights and their legal, political and cultural dimensions. Methods of strengthening and improving these mechanisms to prevent and respond to womens human rights violations. Pre: Graduate Standing
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5704:
Transatlantic Relations
Development and institutionalization of transatlantic political, economic, and security relations. Bilateral and multilateral cooperation frameworks. Theoretical, historical, civilizational, and cultural approaches to the study of transatlantic relations. Impact of the changing security context, domestic politics, and national interests on the evolution of transatlantic relations and common identity. Political and economic causes of tensions and discord between the United States and its European allies and their impact on European security and world order. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5714:
European Union
Theories of European integration. History, organizational structure, political dynamics, decision-making mechanisms, and policy-making processes of the European Union (EU). EU's political system and international actorness. Survey of EU's major internal and external policies and their impact on transatlantic political, economic, and security relations. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PSCI 5724:
European Political Economy
The politics of European economic integration. Organizational structure, decision-making mechanisms, policy-making processes, and policies of major European and transatlantic economic institutions, such as the European Union (EU), the European Free Trade Association (EFTA), the European Economic Area (EEA), the Eurasian Economic Union (EEU), and the Organization for Economic Cooperation and Development (OECD). Domestic politics and their impact on European and transatlantic economic organizations. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5734:

European Politics & Society

Examination of the political and economic development in Europe. Identification and analysis of the factors leading to the transformation of European politics and markets. Exploration of government, parliamentary, electoral, judicial and party systems in Europe. Investigation of the relationship between state and society in Europe. Examination of the impact of political culture and ideologies on political participation and organized political movements. Investigation of the role of the media and public opinion in European politics. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5744 (GIA 5744):

European Security

Exploration of European security governance. Scope, evolution, structure, decision-making mechanisms, policy-making processes, policies and operations of major security organizations in Europe, such as the North Atlantic Treaty Organization (NATO), the Collective Security Treaty Organization (CSTO), the European Foreign & Security Policy (CFSP) and Common Security and Defense Policy (CSDP), the Council of Europe (CoE), and the Organization for Security & Cooperation in Europe (OSCE). Identification and analysis of the politics and interests affecting their operation. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

PSCI 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

PSCI 6004:

Security, Governance, and Environmental Politics

Application of approaches in political science to critical studies of governance, security, and the environment at subnational, national, and international levels. Advantages and disadvantages of critical approaches to environmental problems. Design of applied research projects in political science and for national and international policymakers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5116, PSCI 5214, (PSCI 5474 OR GIA 5474), GRAD 5104

Corequisite(s):

PSCI 6114 (GIA 6114):

Critical Geopolitics

Critical analysis of geopolitics as spatial discourse about world politics. Examines major concepts in critical geopolitics. Critically reads colonial, fascist, Cold War and post-Cold War geopolitical discourses. Discusses geopolitical knowledge in popular culture. Reviews latest research in the field of critical geopolitics. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5444 OR PSCI 5444 (UG)

Corequisite(s):

PSCI 6124:

Topics in Security Studies

Surveys the interface of globalization and security and the changing paradigm of security within global society. Reviews the impact of globalization on traditional understandings of state security and provides an advanced understanding of the emerging challenges and threats to human and state security. May be repeated with a different topic content for a maximum of 12 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 6144:

Topics in Global Governance

Provides a comprehensive guide to the understanding of contemporary power pressures and responses to global economic and financial change along with its political and social repercussions. Reviews the fields of international political economy, demonstrates the various approaches to adherence and resistance to globalization, and explores the dynamics of the relationship between states and markets.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GIA 5034 (UG) OR GIA 5034 OR UAP 5034 (UG) OR UAP 5034 OR PSCI 5034 (UG) OR PSCI 5034

Corequisite(s):

PSCI 6154:

Topics in European Politics

Analysis of selected European political issues. Democracy and populism. Nationalism, fascism and racism. Religion and religious radicalism. Culture and society in European urban and rural areas and its impact on contemporary European politics. Gender politics and attitudes towards women and LGBTQ in Europe. Social foundations and cultural determinants of marginalization of social groups, migrants and refugees. May be repeated three times with different content for a maximum of twelve (12) credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5734 OR GIA 5734

Corequisite(s):

PSCI 6164:

Topics in Transatlantic Relations

Selected political, cultural, religious, economic, diplomatic and security issues pertaining to transatlantic relations. Topics under examination include: impact of religion and culture on transatlantic relations; US-EU relations and European security; the transatlantic partnership and world order. May be repeated three times with different content for a maximum of twelve (12) credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5704 OR GIA 5704

Corequisite(s):

PSCI 6174:

Topics in EU Policies

In-depth analysis of selected European Union (EU) policies. Topics under examination include the EU's Common Foreign & Security Policy (CFSP), Common Security & Defense Policy (CSDP), environmental policy, energy policy, and climate policy. Organizational structures, decision-making mechanisms, and policy-making processes. Governmental and non-governmental actors and policy-making. Analysis of policy results and effectiveness. May be repeated three times with different content for a maximum of twelve (12) credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5714 OR GIA 5714

Corequisite(s):

PSCI 6184:

Topics in European Security

In-depth analysis of major issues in European security. Topics under examination include the relations between the North Atlantic Treaty Organization (NATO) and the European Union (EU) and their impact on European security; Russia and European security; British foreign and security policy and its impact on European security and transatlantic relations; contemporary threats to European security; and European conflicts and conflict management. May be repeated three times with different content for a maximum of twelve (12) credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSCI 5744 OR GIA 5744

Corequisite(s):

PSCI 6204 (GIA 6204) (ASPT 6014):

Theories of Globalization

Examination of past and present eras of globalization through various theoretical perspectives. Addresses colonialism and emergence of western models for development of poor countries. Controversies about impacts of current globalization on the nation-state, cultures, ecosystems, and racial/ethnic/gender inequalities. Explores present trends, such as globalization of agriculture and food systems, industrial production, migration, human rights, and anti-globalization resistance. Prerequisite may be substituted for any equivalent 5000 level international course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): UAP 5264 OR GIA 5264

Corequisite(s):

PSCI 6214 (GIA 6214):

Democracy Beyond the Ballot

Forms of ultra or enhanced democracy outside of state institutions, particularly those developing in third sector organizations, theories of democracy and research on functioning deliberative democracies at the grassroots level, in societal or international institutions. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GIA 5034 OR UAP 5034 OR PAPA 5034 OR GIA 5164 OR UAP 5164

Corequisite(s):

PSCI 6254:

National Security

Application of security analysis tools to national security issues. Domestic and international security contexts, actors, and processes. Contemporary challenges to national security such as cyber-threats, terrorism, proliferation of weapons of mass destruction, pandemics and environmental threats, organized crime, drug and human trafficking, state failure and state- building, and migration.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GRAD 5104, PSCI 5116, PSCI 5214, (PSCI 5464 OR ASPT 5464)

Corequisite(s):

PSCI 6444:

Topics in Environmental Politics

Contemporary environmental politics. Impact of global climate, economic, and social change on the environment. Political and social repercussions of environmental challenges. Analysis of the dynamic relationships between states and markets in the context of environmental change. May be repeated with different content up to 9 credit hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (PSCI 5364 OR STS 5364) OR (PSCI 5584 OR UAP 5584 OR STS 5584 OR GIA 5584)

Corequisite(s):

PSCI 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSCI 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PSYCHOLOGY

Invalid Use 906652157 Jamie Edgin, Chair

Emeriti Faculty: Danny Axsom; George Clum; Jack Finney; Thomas Ollendick; Richard Winett;

Professors: Martha Ann Bell; Warren Bickel; Brooks Casas; Pearl Chiu; Roseanne Foti; E Geller; Russell Jones; Jungmeen Kim-Spoon; Ian Neath; Angela Scarpa-Friedman; Robert Stephens;

Associate Professors: Charles Calderwood; Rachel Diana; Neil Hauenstein; Robin Panneton; John Richey; Bruce Scarpa-Friedman; Invalid Use 906652157 Jamie Edgin;

Assistant Professors: Rosanna Boljonis; Meagan Brem; Heather Davis Borchetta; Zehra Gulseven; Jorge Hernandez; Louis Hickman; Ning Hsu; Chloe Hudson; Samantha Kempker-Margherio; Tae-Ho Lee; Adrienne Romer;

University Distinguished Professor: Martha Ann Bell; Thomas Ollendick;

Clinical Professors: Lee Cooper;

Alumni Distinguished Professor: E Geller;

Heilig Meyers Professor: Richard Winett;

Senior Instructors: Kurt Hoffman;

Research Professors: Sharon Ramey; Craig Ramey;

Collegiate Assistant Professors: Vanessa Diaz;

General Contact: mwooddel@vt.edu

Graduate Site: https://psyc.vt.edu/grad-info.html

The Department of Psychology at Virginia Tech offers a graduate program leading to the Ph.D. in four concentration areas: Biological Psychology, Clinical Science, Developmental Science, and Industrial/Organizational Psychology. Students earn a Master of Science (M.S.) degree in psychology en route to the Ph.D., but the department does not offer a terminal M.S. degree in any area. Applications from students with either bachelors or advanced degrees are welcomed. Although the graduate curriculum is organized into four specialty areas, all share the same philosophy: to assure that all graduate students are provided with the conceptual, quantitative, and methodological skills necessary to solve theoretical and applied problems. Application deadlines: December 1 for the Biological Psychology, Clinical Science, and Developmental Science concentration areas January 1 for the Industrial/Organizational Psychology concentration area

SPECIAL FACILITIES

Williams Hall is the on-campus home of the Department of Psychology, housing faculty and student offices, research labs, and classrooms. In addition, the department's off-campus Psychological Services Center, Child Study Center, and Virginia Tech Autism Clinic provide the foundation for practicum and research training and offer direct clinical services to children, adults, and families. Additional department resources include three state-of-the-art laboratories dedicated to undergraduate and graduate teaching and research. The psychophysiological laboratory includes computer workstations, EEG/Evoked Potential workstations (including Neuroscan, Coulbourn, and BioPAC equipment), visual acuity and tracking equipment, as well as extensive perception equipment. The psychophysiology laboratory also houses the department's STISIM Drive fully-interactive driving simulator. The department also maintains a computer lab with 20 Dell Optiplex workstations for technology-assisted teaching and research with neurophysiological and cognitive experimental software, statistical analysis software, and data management programs. There is also a dedicated-research computer laboratory including 12 Dell Optiplex workstations with capabilities for running a variety of customized research software. Several faculty are affiliated with the Fralin Biomedical Research Institute at VTC, which offers world-class facilities for behavioral research, the world's premier human functional magnetic resonance imaging facility, and large-scale computational clusters for modeling, simulations, and analyses of large-scale molecular, genomic, biophysical, behavioral, imaging, and population-based data. The Institute also serves as the hub for a worldwide hyperscanning network for interactive, real-time functional brain imaging. Connecting the Institute's three research-dedicated magnetic resonance imaging scanners to multiple sites across the United States and throughout Europe and Asia, this network provides the world's first very-high-throughput functional brain imaging approach to the study of social cognition. This work is enabling new insights not only into how the brains of healthy children and adults make decisions, but also how traumatic brain injury, post-traumatic stress disorder, and a range of neuropsychiatric disorders affect critical decision-making processes.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

M.S.: University minimums for research/thesis and non-thesis credit hours, plus additional specified courses and completion of a Thesis. We do not offer a terminal MS in any area, although students may earn an MS en route to the Ph.D. Details may be found in the student handbook at our website (https://psyc.vt.edu/grad-info.html).

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

Ph.D.: University minimums for research/dissertation and non-dissertation credit hours plus additional specified courses and completion of a Preliminary Examination and Dissertation. Details may be found in the student handbook at our website (https://psyc.vt.edu/grad-info.html).

GRADUATE COURSES (PSYC)

PSYC 5114:

Survey of Industrial-Organizational Psychology

Knowledge and skills to conduct job analyses, develop performance appraisal/management systems, develop psychological assessments, validate psychological assessments, assist organizations in avoiding violations of equal opportunity laws, develop programs to motivate employees, improve leadership skill and facilitate team effectiveness. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5274:

Personality Processes

Theory, research, and application in contemporary personality psychology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5284:

Psychopathology

Fundamental theory and research in the area of psychopathology. Emphasis on empirically derived theories and data concerned with assessment and description of psychopathological behavior.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5294:

Psychophysiology

Intensive study of the distinct psychophysiological methodology and approach to the problem of physiological-behavioral correlation. Several primary areas of psychophysiology are presented: Autonomic-somatic integration and the measurement of psychophysiological activity, the orienting reflex and habituation, the psychophysiological correlates of learning, and patterning factors in psychophysiological response.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5314:

Psychological Perspectives in Social Psychology

Examines reinforcement, field theoretic, cognitive, and role theory, and social learning theory and aggression, social exchange theories, social facilitation, group dynamics, attribution theory, environmental psychology, and impression management.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5315:

Research Methods

Advanced treatment of a variety of research related issues germane to the discipline of psychology, including: the scientific method, elements of the research process, alternative strategies for operationalizing variables, sampling, research ethics, experimental research, quasi-experimental research, non-experimental research, research artifacts, non-traditional research strategies, quantitative literature reviews, and legal problems in research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5316:

Research Methods

Advanced treatment of a variety of research related issues germane to the discipline of psychology, including: the scientific method, elements of the research process, alternative strategies for operationalizing variables, sampling, research ethics, experimental research, quasi-experimental research, non-experimental research, research artifacts, non-traditional research strategies, quantitative literature reviews, and legal problems in research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5344:

Cognitive Psychology

Survey of theoretical and empirical issues in cognitive psychology, including information processing models, attention, memory, problem solving, knowledge, reasoning, neurocognition and intelligence. Historical and current approaches will be considered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5374:

Health Psychology

Theoretical and methodological contributions of the behavioral sciences to problems in the health sciences. Topics include psychosocial factors contributing to health and disease, health promotion, and psychological approaches to the prevention and treatment of physical disabilities.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5404:

Biological Bases of Behavior

History, methods, and special topics relevant to the biological foundations of behavior. Emphasis placed on anatomy, physiology, and pharmacology of nervous system and behavioral correlates including perception, learning memory, motivation, and language.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5544:

Cognitive Development

Cognitive development throughout the life-span. Emphasis on Piagets theory of cognitive development, information-processing approaches, perceptual development, memory development, language development, and alternatives to Piagetian theory. Coverage of the development of social-cognition, particularly communication.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSYC 5534

Corequisite(s):

PSYC 5554:

Social Development

Development of social competence and interactive style during infancy and childhood. Both prenatal and postnatal determinants of normal social behavior, aggression, sex role development, and nonoptimal child-environment interactions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSYC 5534

Corequisite(s):

PSYC 5965:

Clinical Practicum

Supervised training appropriate to the students level of coursework and experience in interviewing, assessment, intervention techniques, community consultation, and applied research in a variety of on and off-campus settings. Maximum of 3 credit hours per course. Approximately 16 hours per week will be the normal training assignment for 3 hours credit; approximately 11 hours per week for 2 hours credit; and approximately 6 hours per week for 1 hour credit.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 16

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5966:

Clinical Practicum

Supervised training appropriate to the students level of coursework and experience in interviewing, assessment, intervention techniques, community consultation, and applied research in a variety of on and off-campus settings. Maximum of 3 credit hours per course. Approximately 16 hours per week will be the normal training assignment for 3 hours credit; approximately 11 hours per week for 2 hours credit; and approximately 6 hours per week for 1 hour credit.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 16

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

PSYC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PSYC 6014:

Quantitative Topics in Industrial and Organizational Psychology

Seminar provides in-depth consideration of one or more current or emergent quantitative topics relevant to the field of Industrial and Organizational Psychology. Example topics include multi-level theories and analytical techniques, meta-analysis, and generalizability theory. May be repeated with different content for a maximum of 6 hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSYC 5315, (PSYC 5316 OR STAT 5214G)

Corequisite(s):

PSYC 6244:

Multiculturalism in Clinical Psychology

Overview of topics related to multiculturalism in the practice of clinical psychology. Exploration of issues related to race, ethnicity, gender, sexual orientation, religion, class, disability, age, and the intersection of these identities. Development of cultural humility, including self-awareness, knowledge of diverse worldviews, and understanding of power and oppression. Acquisition of skills to provide clinical services with cultural humility. Emphasis on commitment to multiculturalism and social justice.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSYC 5284

Corequisite(s):

PSYC 6254:

Advanced Topics in Clinical Psychology

Seminar covering specialized topics in clinical psychology. The course will be concerned with such topics as clinical neuropsychology, pediatric psychology, the psychology of aging, biochemical theories of schizophrenia, and professional and ethical issues. May be repeated to a maximum of 9 hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 6264:

Child Psychopathology

An examination of theoretical issues and current research in the assessment, treatment, and prevention of child behavior disorders. Special emphasis will be placed upon developmental factors and system-wide variables as they impact on the growing child.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSYC 5284

Corequisite(s):

PSYC 6924:

Advanced Topics in Industrial Psychology

Seminar that provides in-depth coverage of theoretical perspectives, research findings, and research strategies used in the study of Industrial Psychology. Topics covered will focus on current research in the areas of selection and criterion development. May be repeated with different content for a maximum of 6 hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSYC 5114 OR PSYC 5115, (STAT 5605, STAT 5606) OR (STAT 5615, STAT 5616) OR (STAT 5665, STAT 5666)

Corequisite(s):

PSYC 6934:

Advanced Topics in Organizational Psychology

Seminar that provides in-depth coverage of theoretical perspectives, research findings, and research strategies used in the study of Organizational Psychology. Topics covered will focus on current research in the areas of micro and macro organizational psychology. May be repeated with different content for a maximum of 6 hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PSYC 5124 OR PSYC 5125 OR PSYC 5126, (STAT 5605, STAT 5606) OR (STAT 5615, STAT 5616) OR (STAT 5665, STAT 5666)

Corequisite(s):

PSYC 6944:

Advanced Topics in Developmental Psychology

Seminar covering specialized topics in developmental psychology. The course will be concerned with such topics as the life-span perspective, early identification of at-risk newborns, preventive interventions, and new conceptual foundations. May be repeated to a maximum of 9 hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 6954:

Advanced Topics in Psychological Sciences

Seminar covering advanced, specialized biobehavioral topics in Psychological Sciences. The course will be concerned with such topics as biobehavior, psychophysiology, cognitive neuroscience, sensation and perception, learning and cognitive psychology. May be repeated to a maximum of 12 hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 6965:

Clinical Practicum

Supervised training appropriate to the students level of coursework and experience in interviewing, assessment, intervention techniques, community consultation, and applied research in a variety of on- and off-campus settings. Maximum of 3 credit hours per course. Approximately 16 hours per week will be the normal training assignment for 3 hours credit; approximately 11 hours per week for 2 hours credit; and approximately 6 hours per week for 1 hour credit.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 6966:

Clinical Practicum

Supervised training appropriate to the students level of coursework and experience in interviewing, assessment, intervention techniques, community consultation, and applied research in a variety of on- and off-campus settings. Maximum of 3 credit hours per course. Approximately 16 hours per week will be the normal training assignment for 3 hours credit; approximately 11 hours per week for 2 hours credit; and approximately 6 hours per week for 1 hour credit.

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 7964:

Clinical Internship

During the third, fourth, fifth, or sixth year the clinical student shall be involved in a full-time supervised internship program in a clinical setting approved by his/her advisory committee and the director of clinical psychology training program. The minimum duration shall be 11 months. Course may be repeated a maximum of four times for a maximum of 48 hours.

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PSYC 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PUBLIC ADMINISTRATION AND PUBLIC AFFAIRS

Karen Hult, Chair

Emeriti Faculty: Brian Cook; Larkin Dudley; Charles Goodsell; Gary Wamsley;

Professors: Karen Hult; Sharon Mastracci;

Associate Professors: Matthew Dull; Laura Jensen; Joseph Rees; Stephanie Smith;

Assistant Professors: David Bredenkamp; Adrienne Edisis; Eric Malczewski; Raymond Zuniga;

Collegiate Associate Professor: Stephanie Davis;

Senior Instructors: Stephanie Davis;

General Contact: mcolle6@vt.edu

General Contact: elia@vt.edu

Center for Public Administration and Policy: http://www.cpap.vt.edu/

The mission of the Virginia Tech Center for Public Administration and Policy (CPAP) is to promote good governance and the advancement of capable and ethical public service by providing outstanding education, research and outreach in the theory and practice of public administration, management, and policy. CPAP seeks: To provide qualified public service professionals currently in service and pre- or early-career students who plan to become public service professionals with a rigorous program of study for developing managerial, analytical and normative evaluation skills in public management and public policy. To prepare teachers and scholars for faculty service in colleges and universities around the country and the world, thereby broadening the scope of knowledge in public administration and policy studies among administrators and citizenry. To engage faculty, practitioners, and graduate students in systematic research and study designed to improve the quality of policy making and public service within the varied jurisdictions of government in the Commonwealth of Virginia and the national capital region, as well as nationally and internationally. CPAP offers two degrees: the Master of Public Administration (MPA) and the PhD. in public administration and public affairs. The MPA is offered in Blacksburg, Arlington, Richmond, and virtually. The Ph.D. is offered in Blacksburg and Arlington. CPAP is also home for two graduate certificates, in Homeland Security Policy and in Local Government Management.

SPECIAL FACILITIES

Beyond the main campus in Blacksburg, Virginia, CPAP offers students opportunities to earn the MPA and the PhD in the rich learning environments of Arlington, VA (adjacent to Washington, DC), Richmond, VA, the state capital (MPA only), and virtually (MPA only).

Arlington - Virginia Tech Research Center

The CPAP Program in Arlington is housed in the Virginia Tech Research Center — Arlington.   Located at 900 N. Glebe Road, The Virginia Tech Research Center — Arlington is a highly visible state-of-the-art facility designed to further the university's mission to expand its research portfolio in the greater Washington, D.C., metro area. The region offers great opportunities for partnerships with corporate research entities and close proximity to government agencies and other public and private-sector organizations. The building is located in the vibrant Ballston district of Arlington, a short distance from many of the leading science and research agencies of the federal government and many high-technology companies.

Blacksburg - Thomas-Conner House

Situated just off the main Virginia Tech campus in downtown Blacksburg, VA, the historic, Thomas-Conner House is CPAP's headquarters and home to a thriving academic community for MPA and Ph.D. students.

Richmond

SPIA’s Richmond Campus allows you to achieve a graduate certificate on-line, apply for a full-time fellowship with the Commonwealth of Virginia, or bring leadership courses and programs into your government agency office or nonprofit. Our faculty are scholars and practitioners experienced in optimizing individual and organizational performance. The Richmond Campus is the hub for SPIA's sponsored research programs for nonprofit and public organizations. More than 40 faculty and affiliated faculty participate in the research, design, and implementation of sponsored programs with organizations ranging from the Governor’s Office of the Commonwealth of Virginia to an international nonprofit situated in Egypt. While the campus is based in Richmond, we go where the research, learning, and educational needs are: we are embedded scholars. https://spia.vt.edu/visit/richmond.html

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

A minimum of 90 credit hours is needed for the Ph.D. in Public Administration and Public Affairs. A maximum of one half of the coursework required for the CPAP Ph.D., or 30 of 60 credit hours, may be transferred from an accredited university other than Virginia Tech upon approval by two core faculty evaluating the student's program of study. The 60 credit hours of required coursework encompasses foundation courses, advanced topics and capstone courses, measurement courses, and research concentration courses. Students must also take 30 hours of research and dissertation credit, three hours of which must be constituted by participation in 15 sessions of the Doctoral Mentoring Program (DMP) or other activities approved by the faculty for DMP credit. Entering students must have completed courses in United States Government, Micro-economics, and Introductory Statistics with a grade of C+ or better. Students without all prerequisites completed must complete the missing prerequisites as soon as possible and before enrolling in PAPA 6224. Test scores (GRE or GMAT) are optional.

MPA Degree

Offered In (Virtual, Richmond, Blacksburg, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

All M.P.A. students must complete nine required 3-credit courses, plus three elective courses of their choosing, plus a portfolio for a total of 39 credit hours. Test scores (GRE or GMAT) are optional.VT undergraduates majoring in Smart and Sustainable Cities (SSC) or Environmental Policy and Planning (EPP), with a cumulative GPA of at least 3.5 and at least 90 credit hours of the undergraduate degree completed, may also apply for the Accelerated Undergraduate/Graduate degree program.

GRADUATE COURSES (PAPA)

PAPA 5014:

Concepts and Approaches to Public Administration

Covers the origins and development of the administrative state. Surveys major theoretical approaches to public administration. Discusses the problem of values in administration, the political environment of bureaucracy, and questions of ethical behavior in administration.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5024:

Introduction To Public and Nonprofit Financial Management

Introduction to central concepts in financial management for public and nonprofit organizations. Accounting, financial statements and management reporting, auditing, internal control systems, accountability, and approaches to assessing the financial condition of public and nonprofit entities. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5034 (UAP 5034) (GIA 5034):

Democratic Governance in the Economy

Interplay between democratic politics upon economic relations, with special focus on the intellectual foundations of capitalist development and consequences of financial disruption to economic policy making. Evolution of state-market interactions and of global governance institutions. Case studies of financial crises and their political implications. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 5044:
Local Government and the Professional Manager
Covers the origin and development of the administrative state. Surveys major theoretical approaches to public administration. Discusses the problem of values in administration, the political environment of bureaucracy and questions of ethical behavior in administration. Particular attention given to the local government context and the local public managers role. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 5214 (SOC 5214):
Research Methods
Research methods in sociology including survey methods, qualitative methods, and experimental design. The link between social theory and social research. Measurement, validity, reliability, and the logic of data analysis.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 5254:
Homeland Security and the Terrorist Threat
A multidisciplinary introduction to theory, strategy, decision making, and doctrine of Homeland Security as practiced in the U. S. Describes the threat, nature of current global conflicts in which the U. S. is engaged, Americas foreign and domestic policy responses to 9/11, and strategic and operational homeland security functions. Prerequisite: Graduate standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 5315:
Government Administration
5315: The first of a sequence of two, provides theoretically grounded but practical knowledge on behavioral skills necessary for the public manager. These include the ability to lead, to supervise, to organize, and to communicate in public settings and in agencies serving the community and society. 5316: The second of a sequence of two, teaches the techniques and technology necessary to manage public organizations efficiently and effectively and to be held accountable for administrative actions and programs.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 5316:
Government Administration
5315: The first of a sequence of two, provides theoretically grounded but practical knowledge on behavioral skills necessary for the public manager. These include the ability to lead, to supervise, to organize, and to communicate in public settings and in agencies serving the community and society. 5316: The second of a sequence of two, teaches the techniques and technology necessary to manage public organizations efficiently and effectively and to be held accountable for administrative actions and programs.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 5354:
Homeland Security and Response &Recovery
Multi-disciplinary policy course focused on emergency response and recovery following catastrophic manmade disasters in the U. S. Emphasis on strategic and operational decision making; response models and strategies; the preparations, response and recovery roles and responsibilities of federal, state and local jurisdictions; and federal policy alternatives to address the complex resource challenges of multi-jurisdictional response planning and operation execution. Prerequisite: Graduate standing required.
Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5614 (STS 5614):

Introduction to Science and Technology Policy

Strategies for science and technology policy; science education; scientific and technical information for societal uses; government and public policy; resource allocation; economy and global exchanges of science and technology; approaches to policy evaluation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5674:

Financial Health of Public and Nonprofit Organizations

Concepts and analytical capacities necessary to evaluate the overall level of financial health of governmental and nonprofit/nongovernmental organizations. Examines the tools and techniques necessary to assess the financial condition of the organizations and to determine if they have the capacity to carry out their purposes and address their debt obligations. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5694:

Asset Management for Public and Nonprofit Organizations

Provides an understanding of asset management for governmental and nonprofit/nongovernmental entities. Focuses on the essentials of cash budgeting and cash management, investment of endowments and pension funds, and debt management and debt financing for governmental and nonprofit/nongovernmental organizations. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5784:

Economic Devel Planning Topics

An introduction to local economic development programs. Covers intergovernmental relations, financing techniques, federal and local subsidies, advertising, marketing, public relations, labor market issues, tax considerations, fiscal impact analysis, and land use planning issues. May be repeated with different topics for a maximum of 9 credits. Graduate standing required.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

PAPA 5954:

Internship in Public Administration/public Affairs

For students without substantial previous management or staff experience and for students changing positions or career. Supervised work and academic experience.

Credit Hour(s): 1 TO 15

Lecture Hour(s): 1 TO 15

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

PAPA 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

PAPA 6014:

Public Administration Theory

Examines the epistomological-ontological basis of public administration study; recent and current issues in the practice of public administration; and perspectives of the Center faculty concerning the direction of the field.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6114:

Complex Public Organizations

Examines the principal conceptual and theoretical bases for understanding the structure and environment of complex public organizations; also explores the problems bureaucracy poses for democratic theory and for vigorous economy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6154:

Advanced Topics in Public Organizations

Selected topics of theory, methodology, and design in current research literature on complex public organizations and large-scale bureaucratic systems. The political environment of such systems will be emphasized.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6214:

Public Policy Processes and Analytical Approaches

Examines in a general way, the field of public analysis in and for government. Covers the traditions and assumptions of the field; notes and critiques the literature; examines relationships to other fields and topics of public administration; and discusses the processes of policy-making and techniques of analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6224:

Design, Implementation, and Evaluation of Public Policy and Programs

The general purpose of this course is to develop an understanding of the process by which policy is formulated, analyzed, implemented, and evaluated. The focus will be on such actions as undertaken by policy analysts in and out of government. The methodological issues and techniques used to accommodate the major social, economic, political, and behavioral aspects of policy analysis in an organizational context will be discussed.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6254:

Advanced Topics in Public Policy

Selected topics in public policy analysis and program evaluation. Theoretical perspectives, methodological issues, and current research on selected policies and programs at international, national, or

subnational levels, etc.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 6264:

Advanced Topics in Policy Systems Management

Focus on critical integration of policy and management concerns in national strategy that represent a point of synthesis of external and internal policy arenas in such selected areas as: national and international security, politico-economic risk in overseas operations of U.S. institutions, crisis and emergency management, technoscience and resource systems, and information resource systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 6294:

Capstone Seminar in Public Policy

Conceptualization and research into the processes of policy analysis and program evaluation in the public sector. Selected conceptual, methodological, organizational, and ethical problems associated with the analysis, implementation, and evaluation of public policies and programs.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 6314:

Public Budgeting Processes and Their Policy Implications

Surveys the public budgeting processes of public organizations. The contrasting norms and behaviors of participants, their impacts on policy, and their implications for democracy are examined. Processes studied include the work of budgeteers, decision making processes, control and financial accounting, and intergovernmental interaction.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 6324:

Public Personnel Processes and Their Policy Implications

Surveys the key personnel processes of public organizations, the contrasting norms and behaviors of participants, their impacts on policy, and their implications for democracy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 6344:

Ldrship & Mgt Process Pub Adm

Conceptual and theoretical bases for understanding leading and managing in the context of public organization processes and functions such as budgeting and financing human resource management, acquisitions, information technology, and planning. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 6354:

Advanced Topics in Public Management

An examination at an advanced level of a selected managerial process in the public sector (civil and military), the norms and participant behavior associated with the process, its efficacy in planned change, and its overall impact on policy making and implications for democracy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PAPA 6394:

Capstone Seminar in Public Management

Original conceptualization of and research into specific aspects of management processes in the public sector. Opportunities and problems in using management processes to institute planned change.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6414:

Normative Foundations of Public Administration

The course will examine the discretionary judgments of administrators as the central normative issue in the field of public administration and will look to constitutional principles for guidance in the responsible exercise of administrative discretion. Particular emphasis will be placed on selected court decisions to compare and contrast legal and moral reasoning.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6454:

Advanced Topics in Ethics and the Public Sector

This is an advanced course in the Centers curriculum area dealing with ethics and the normative theory of the state. It will examine the theoretical basis of ethical standards in the field of public administration. Special emphasis will be placed on the Ethics in Government Act of 1978 and the Code of Ethics of the American Society for Public Administration.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6514:

Public Administration and Policy Inquiry

Provides students with a general background in the design and execution of inquiry in public administration and policy. Includes examination of concepts, issues and problems of inquiry design, measurement, data collection, analysis, and the application of computers, and other information processing tools to support research and decisionmaking in public administration and policy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6524:

Advanced Quantitative Methods in Public Administration & Policy

Advanced quantitative methods for the public administration and policy, including logit and probit models, factor analysis, structural equation models, and social network analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PAPA 6514

Corequisite(s):

PAPA 6664:

Advanced Topics in Science and Technology Policy

Variable topics in science and technology policy. Includes advanced study of science, technology, and economy; science, technology, and power; strategies for research and development policy --public and private sector; transfer of technology; technological forecasting; government regulation and responses; science policy assumptions and challenges, specialist knowledge and expertise; state and academic knowledge production; issues of race, class, gender, and national identity in policy work. May be repeated with a different topic for a maximum of 6 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 7954:

Internship in Public Administration/public Affairs

For students without substantial previous management or staff experience and for students changing positions or career. Supervised work and academic experience.

Credit Hour(s): 1 TO 15

Lecture Hour(s): 1 TO 15

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 7964:

Field Study

Applied research and/or evaluation study in cooperating government agency as part of a team of advanced graduate students and faculty.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PAPA 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

PUBLIC HEALTH

Laura Hungerford, Head

Emeriti Faculty: Frank Pierson;

Professor: Laura Hungerford; Kerry Redican;

Associate Professor: Andrea Bertke; Julia Gohlke; Kathryn Hosig; Audrey Ruple;

Assistant Professor: Ryan Calder; Alasdair Cohen; Natalie Cook; Cassidy Rist; Nick Ruktanonchai;

Associate Professor of Practice: Jacquelyn Pelzer; Valerie Ragan;

Assistant Professor of Practice: Nicole Holt; Sophie Wenzel;

Collegiate Assistant Professor: Cornelia Deagle;

Research Professor: Lisa Lee;

Collegiate Associate Professor: Yuba Gautam;

General Contact: phs@vt.edu

Graduate Site: https://publichealth.vt.edu/

The Master of Public Health (MPH) is a professional degree that prepares graduates to practice public health in local, state, regional, national, and global settings. The Council on Education for Public Health (CEPH) accredits schools and programs in public health to ensure that their curriculum is appropriate to effectively prepare students to enter the public health workforce. Requirements include a supervised practice experience where the student assumes job functions in public health. Additionally, participation in a final culminating experience demonstrating competence in the field is required. Students in other graduate or professional degree programs often add the MPH degree to broaden their training and job prospects. In order for students to fully appreciate and assimilate the content, the 42-credit program is designed as a two-year, four-semester experience for full-time students with options for part-time, accelerated, dual, and simultaneous degree studies. The program intentionally sequences the courses to ensure continuity in course materials and effective preparation for public health practice. Students formulate their plan of study with faculty advisors to include 22 core credits, 9 concentration credits, and 8 professional preparation credits. The MPH degree program offers two concentrations: Infectious Disease and Community Health Promotion and Equity. Standalone MPH applicants may only apply for admission to enter the program in the fall semester. All application materials are due by March 1 (Review of verified applications will begin January 5). Standalone degree MPH applicants (pursuing the degree either full- or part-time) should submit all of the required application materials listed below to SOPHAS. More information about the application process for standalone MPH applicants can be found on our website here. Entry terms and application instructions for our accelerated (BSPH/MPH, BS/MPH, BA/MPH), dual (DVM/MPH, MD/MPH), and simultaneous degree (PhD/MPH, MS/MPH, MA/MPH, etc.) vary. Information on each of these programs can be found on our website here.

SPECIAL FACILITIES

The MPH program is primarily physically located in the Virginia-Maryland College of Veterinary Medicine (VMCVM) on the Virginia Tech campus. The majority of faculty and staff offices are located at the VMCVM and MPH classes are held at the VMCVM. Additional program faculty have their offices adjacent to their labs in other Virginia Tech buildings, including the Integrated Life Sciences Building (ILSB) and the Center for One Health Research (COHR).

Virginia-Maryland College of Veterinary Medicine - Blacksburg campus

Address: 205 Duck Pond Drive (0442), Blacksburg, VA 24061

DEGREES OFFERED

MPH Degree

Offered In (Blacksburg)

The 42-credit program is designed as a two-year, four-semester experience for full-time students with options for part-time, accelerated, dual, and simultaneous degree studies. The program intentionally sequences the courses to ensure continuity in course materials and effective preparation for public health practice. Students complete 22 core credits, 9 concentration credits, and 8 professional preparation credits. The MPH degree program offers two concentrations: Infectious

Disease and Community Health Promotion and Equity. For information on degree requirements, please visit our website or contact us at phs@vt.edu or 540-231-3945. MPH Core Courses: PHS 5004: Foundations of Public Health PHS 5054: Public Health Leadership and Interprofessionalism PHS 5025: Epidemiology and Quantitative Methods in Public Health I PHS 5026: Epidemiology and Quantitative Methods in Public Health II PHS 5024: Lab for Epidemiology and Quantitative Methods PHS 5034: Health Behavior and Health Education PHS 5044: Public Health Policy and Administration PHS 5064: Public Health Program Development and Evaluation PHS 5014: Environmental Health MPH Professional Preparation Courses: PHS 5935: Preparation for Public Health Practice I PHS 5936: Preparation for Public Health Practice II PHS 5964: Public Health Practice Experience (PHPE) PHS 5934: Public Health Integrative Learning Experience (ILE) or PHS 5924: Capstone in Public Health

Degree Concentrations:

Community Health Promotion and Equity Concentration

Community Health Promotion and Equity Concentration Competencies: Design health education messages for specific public health issues and target audiences using appropriate communication channels and technologies. Design a health education session for a specific target audience, using appropriate principles, theories and models of health education. Apply key models for community organizing and capacity-building to help communities address priority population health needs. Facilitate inclusive engagement and collaborative decision-making with diverse stakeholders to prioritize and address public health concerns. Apply the principles of social epidemiology to explain health inequities as they pertain to critical health outcomes. Devise community-engaged practice and policy solutions to advance health equity at individual, community and societal levels. Near completion of the MPH degree, students that have completed the Community Health Promotion and Equity Concentration courses will demonstrate proficiency in the main areas of responsibility defined by the National Commission for Health Education Credentialing (NCHEC) and be eligible to sit for the Certified Health Education Specialist (CHES) exam. Community Health Promotion and Equity Concentration Courses: PHS 5204: Principles of Community Health Education PHS 5254: Social Epidemiology and Health Inequities PHS 5234: Methods in Community Health Engagement

Infectious Disease Concentration

Infectious Disease Concentration Competencies: Demonstrate knowledge of infectious disease processes in individuals, including microbiology and pathogenesis of bacterial, viral, parasitic, and fungal organisms, and the host response. Design effective communication strategies to convey infectious disease information to a variety of audiences. Identify and evaluate the temporal and spatial dynamics of causes and risk factors for infectious diseases in populations. Describe and analyze host, agent, and environmental dynamics, including ecological, genetic, economic and social factors for infectious disease transmission in populations. Design interventions, policies, and procedures for control and prevention of infectious diseases in communities and populations, including sources, dissemination, antimicrobial resistance, vaccines, food and water safety, and hospital-based infections. Develop evaluation plans for infection control and prevention applicable to broad variety of settings, from local community to global settings. Critically evaluate global health challenges that contribute to persistence of neglected infectious diseases and emergence of new infectious diseases. Apply public health and research concepts to One Health oriented interventions and studies, including the ability to critically assess current practices and research, define problems, and design strategies to eradicate and respond to infectious diseases. Infectious Disease Concentration Courses: PHS 5334: Principles of Infectious Disease PHS 5314: Infectious Disease Epidemiology PHS 5324: Public Health Infection Control and Prevention

GRADUATE COURSES (PHS)

PHS 5004:

Foundations of Public Health

Foundational principles of public health, including history, core functions and essential services. Public health ethics and values. Career opportunities in the public health core disciplines. Biologic determinants of health. Global and One Health frameworks for health and health professionals. Pre: Graduate standing.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHS 5014 (VM 7014):

Environmental Health

Exploration of major environmental health concepts and issues, environmental policies and regulations. Topics include world population and pressures on the environment, healthy environment; environmental determinants of public health, including biological, physical and chemical factors; environmental factors affecting disease vectors and their control; air and water quality; waste management; the built environment, work environments and recreational area; food protection and safety; occupational health; tools for environmental evaluation, planning and safety. Pre: Graduate Standing or permission from the instructor.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):

Corequisite(s):

PHS 5024:

Epidemiology and Quantitative Methods in Public Health Lab

Statistical skills needed to conduct epidemiologic and public health research including descriptive statistics, bivariate statistics, and regression. Reading and writing code. Manipulate, analyze, and visualize public health data using statistical software. Probability, confidence intervals, and significance. Statistical power. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab, VB

Instruction Type(s): Lab, VB

Prerequisite(s):

Corequisite(s): PHS 5026

PHS 5025:

Epidemiology and Quantitative Methods in Public Health

5025: Investigation and analysis of dynamics and determinants of disease in communities and populations. Philosophy, assessment, and application of public health science, ethics, study design, data analysis, and epidemiologic measures. 5026: Basic ideas, methods, and measures of epidemiology. Statistical knowledge and skills to analyze and interpret data from epidemiologic studies. Introduction to common statistical packages. Evaluation of scientific evidence from literature. Identify and minimize major potential sources of error in epidemiologic studies. Pre: Graduate standing for 5025.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5026:

Epidemiology and Quantitative Methods in Public Health

5025: Investigation and analysis of dynamics and determinants of disease in communities and populations. Philosophy, assessment, and application of public health science, ethics, study design, data analysis, and epidemiologic measures. 5026: Basic ideas, methods, and measures of epidemiology. Statistical knowledge and skills to analyze and interpret data from epidemiologic studies. Introduction to common statistical packages. Evaluation of scientific evidence from literature. Identify and minimize major potential sources of error in epidemiologic studies. Pre: Graduate standing for 5025.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHS 5025

Corequisite(s):

PHS 5034:

Health Behavior and Health Education

This course has two main purposes: (1) to familiarize students with historical, theoretical and methodological aspects of health psychology, and (2) to acquaint health education students with the social, psychological, and cultural determinants of health behaviors which form the underpinnings of health education practice.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5044 (HNFE 5694):

Public Health Policy and Administration

Multiple dimensions of the health policy-making process including the roles of ethics and evidence. Analyzing health polices for their impact on public health and health equity. Examining the structure and function of health care models nationally and globally. Constitutional basis for public health. Applying principles of planning, organizing, directing, staffing, and budgeting to public health agencies. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5054:

Public Health Leadership and Interprofessionalism

Fundamentals of public health leadership and management using a systems-thinking lens. Decision-making, change management, shared vision, and communication. Strategic planning and public health ethics. Negotiation role-playing. Models of team effectiveness. Team building applied to working on public health and interprofessional teams. Collaborative leadership, personal leadership styles, and self-reflection. Diversity and cultural competency in the public health setting as a leader. Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5064 (VM 5064):

Public Health Program Development & Evaluation

Development and evaluation of public health education and infectious disease programs. Health equity, systems thinking, and cultural responsiveness throughout the program development and evaluation cycle. Assessment of community health needs. Engagement of diverse stakeholders. Effective public health program design. Development of evaluation plans to assess processes, outcomes, and impacts. Relationship between program development, ongoing evaluation, and improvement. Communication of evaluation findings to stakeholders. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5204:

Principles of Community Health Education

Public health issues and concepts are analyzed and evaluated in relationship to existing principles of health education.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5214 (HNFE 5684):

Program Development in Health Education

Theory, trends, and design of community health education programs implemented in communities, health agencies, hospitals, and industry. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5224:

Comp Health Systems

Comprehensive examination of the structure and function of worldwide healthcare and public health systems. National health services with central funding, social insurance programs, decentralized systems, and private insurance systems. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5234:

Methods of Community Health Engagement

This course is designed to present core concepts, models, methods, strategies and challenges in the process of working with communities to improve community-identified population health needs. This course presents an overview of models for community organizing and community capacity building and provides students the opportunity to apply classroom concepts “in the field” through working with community partners and the development and presentation of a group Needs Assessment in collaboration with the community partner. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5244:

Sexual Health and Human Rights

Sexual and reproductive health from human development, public health, and critical feminist perspectives, with special attention to human rights issues. Sexually transmitted infections; HIV/AIDS; unintended pregnancy; population policies; eugenics; sexual and reproductive rights; positive sexuality, sex education; and health promotion. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5254 (HD 5254):

Social Epidemiology and Health Inequities

Social determinants of health through the life-course. Relationship of social injustice to public health. Interplay of major social factors such as poverty, race and gender to influence health domestically and globally. Application of social epidemiology to a range of health outcomes. Inform effective solutions to health inequities. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5314 (VM 7314):

Infectious Disease Epidemiology

Dynamics and determinants of infectious diseases and their assessment on the molecular to population continuum in a systems based approach. Infectious disease transmission mechanisms; population susceptibilities; environmental, social, cultural and economic contributors to infectious disease propagation; detection and surveillance; geographic information systems; epidemiologic study design; and infectious disease modeling.

Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5324 (VM 9324):

Public Health Infection Control and Prevention

Assessment, policies, and procedures for control and prevention of infectious diseases in communities and populations. Sources, transmission mode, and local community to international dissemination of infectious disease agents; antimicrobial and chemical resistance; vaccine development, safety, and coverage; community and hospital based needs and interventions; and regulatory frameworks. Pre: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5334 (VM 9334):

Principles of Infectious Diseases

Principles of infectious diseases important for local, national, and global public health. Bacterial, viral, fungal, and parasitic pathogens; mechanisms of disease; host immune response to pathogens. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5344 (VM 9344):

Neglected & Emerging Infectious Diseases in Public Health

Neglected infectious diseases and their association with marginalized populations and factors including poverty, social and health inequities, water, sanitation and hygiene, and urbanization. Critical factors for emergence/re-emergence of infectious diseases in populations and regions, including geopolitical challenges, zoonotic and vector impacts. Evaluate studies and global responses to neglected and emerging infectious diseases to inform the development of One Health interventions. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5704 (CEE 5704):

Drinking Water & Health

Drinking water contamination and associated health outcomes. Programs to improve safe water access. Viral, bacterial, protozoal, and helminthic pathogens. Heavy metals, pesticides, and other contaminants. Drinking water treatment and supply in rural areas. Study designs for health outcome assessment. Field-based intervention trials. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5714:

Health of the Elderly

The health needs and problems of the elderly, the implications for those working with the elderly, and possible health care delivery systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5724:

Ethical Foundations of Public Health

Methods for ethics decision-making in public health and health policy, exploration of theoretical foundations of ethical public health practice, methods for identifying ethical challenges and ethical dilemmas, skills for managing ethical ambiguity, differences and similarities between professional ethics, research ethics, clinical ethics, and public health ethics, key historical events in public health that led to ethical and policy requirements, decision-making frameworks to analyze public health ethical challenges, current writings in public health ethics literature, well-reasoned written and oral arguments for a course of action to address public health ethics dilemmas. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

PHS 5914:

Practicum in Public Health

Public health theories and concepts in a work setting; comprehensive, structures experience requires student to demonstrate professional competencies while working closely with a supervisor in a public health practice setting. Pre-requisite: Graduate Standing and completion of 24 hours of MPH degree coursework.

Credit Hour(s): 6

Lecture Hour(s): 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5924:

Capstone in Public Health

Synthesis of coursework and practicum experience into a final comprehensive product which integrates knowledge and skills acquired in all core classes, specific MPH concentration courses and practicum experience for developing, implementing and evaluating a public health program; tests students ability to effectively analyze a public health problem and develop an intervention toward a solution to the problem. Pre-requisite: Graduate standing; completion of 39 hours of MPH coursework including enrollment in or completion of public health practicum.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5934:

Public Health Integrative Learning Experience

Culminating experience required for the MPH degree. Integration of program foundational and concentration-specific competencies. Team-based public health educational and professional experience. Addressing a public health challenge. Working with a mentor from an external stakeholder organization. Producing individual high-quality written deliverable. Reflection on the learning experience. Team presentation of project. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

PHS 5935:

Preparation for Public Health Practice

Preparation for the public health profession. Covers the necessary skills to become a successful public health professional. 5935: Exploration of Public Health Practice Experience (PHPE) placement opportunities. PHPE goals, objectives, and competencies. PHPE products that align with academic and professional goals. PHPE learning contract. Institutional review board (IRB) protocols. Communications and professionalism skills. Academic poster and e-portfolio design. Work/life balance strategies. 5936: Examination of professional preparation for careers in public health. Job search strategies, resume/CV and cover letter writing, interviewing, and networking. Workplace skills, including

professional communication, group process, leadership/supervision skills, working with the media, and survey design and data presentation. Personal/professional growth strategies, including salary and benefits negotiation, debt management, and time management. Grant writing. Pre: Graduate standing; 5935 for 5936. Pass/Fail only.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHS 5936:
Preparation for Public Health Practice
Preparation for the public health profession. Covers the necessary skills to become a successful public health professional. 5935: Exploration of Public Health Practice Experience (PHPE) placement opportunities. PHPE goals, objectives, and competencies. PHPE products that align with academic and professional goals. PHPE learning contract. Institutional review board (IRB) protocols. Communications and professionalism skills. Academic poster and e-portfolio design. Work/life balance strategies. 5936: Examination of professional preparation for careers in public health. Job search strategies, resume/CV and cover letter writing, interviewing, and networking. Workplace skills, including professional communication, group process, leadership/supervision skills, working with the media, and survey design and data presentation. Personal/professional growth strategies, including salary and benefits negotiation, debt management, and time management. Grant writing. Pre: Graduate standing; 5935 for 5936. Pass/Fail only.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): PHS 5935
Corequisite(s):

PHS 5964:
Practicum
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHS 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study, VI
Instruction Type(s): Independent Study, VI
Prerequisite(s):
Corequisite(s):

PHS 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

PHS 8984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

REGENERATIVE MEDICINE

Professors: Linda Dahlgren; Rafael Davalos; Sally Johnson;
Associate Professors: Jennifer Barrett; Christopher Byron; Aaron Goldstein; Jia-Qiang He; Ashley Heflin; William Huckle; Michelle Theus; Vincent Wang; Abby Whittington;
Assistant Professors: Sophie Bogers; Blake Johnson; Paul Morton; Eli Vlaisavljevich;
College of Veterinary Medicine: Jennifer Barrett; Sophie Bogers; Christopher Byron; Linda Dahlgren; Willard Eyestone; Jia-Qiang He; William Huckle; Paul Morton; Michelle Theus;
College of Engineering: Rafael Davalos; Aaron Goldstein; Blake Johnson; Eli Vlaisavljevich; Vincent Wang; Abby Whittington;
Adjunct Faculty: Willard Eyestone;
College of Liberal Arts & Human Sciences: Ashley Heflin;
College of Agriculture and Life Sciences: Sally Johnson;

Aaron Goldstein: goldst@vt.edu
Linda Dahlgren: lad11@vt.edu
Graduate Site: http://www.regenmed.vetmed.vt.edu

Regenerative medicine (RM) is a new medical approach that seeks to restore both structure and function of tissues lost to injury, disease or congenital defects. This field incorporates use of stem cells, proteins that stimulate healing, and engineered biomaterials to help cure diseases from diabetes to osteoarthritis. Regenerative strategies are modeled on mechanisms drawn from embryonic development and naturally-occurring examples of regeneration. This field represents a paradigm shift in biology, medicine and biomedical engineering. Ethical and societal impacts need to be considered as this rapidly expanding technology is developed. Furthermore, the swift translation of these technologies to the clinical realm provokes a need for both public policy considerations and practical feasibility from a business perspective. Leaders in RM must have training, understanding and interactions across diverse disciplines. The Regenerative Medicine Interdisciplinary Graduate Education Program (IGEP) team aims to produce leaders in RM by training students in the broad complexities inherent to the field, beyond expertise gained in their specific disciplines. The IGEP will be among the first programs of its kind to equip students with a broad-based, graduate-level education in the field of RM. Colleges and Departments:College of Veterinary Medicine Biomedical Sciences and Pathobiology Large Animal Clinical Sciences Small Animal Clinical Sciences College of Engineering Materials Science and Engineering Chemical Engineering Engineering Science and Mechanics Biomedical Engineering and Mechanics College of Liberal Arts and Human Sciences Science and Technology in SocietyCollege of Business Marketing ManagementFor more information please contact Principal Investigators Linda Dahlgren (lad11@vt.edu) or Aaron Goldstein (goldst@vt.edu) or visit our website.

SPECIAL FACILITIES

The program takes advantage of access to facilities within all of the four programmatic areas.

Goodwin Hall

Goodwin Hall is the flagship building for the College of Engineering. It houses 40 instructional and research labs, eight classrooms, the Quillen Family Auditorium, and 150 offices for several engineering departments. More than classrooms, offices, and laboratories, Goodwin Hall is a ground-breaking experiment to measure even the smallest vibrations made inside the building. The project is designed as a test bed to track data related to building design and security, occupancy monitoring for emergency response, structural health monitoring, and more. Roughly 240 accelerometers attached to 136 sensor mounts throughout the building's ceilings will detect information on where people are within the structure, measure normal structural settling and wind loads, and track building movement resulting from earthquakes similar to the event that struck Virginia in 2011. A sensor array mounted outside the building will measure external vibrations, such as wind, the bustle of traffic on nearby Prices Fork Road, the thunderous boom of tens of thousands of Hokie fans celebrating a touchdown at Lane Stadium, and possible seismic activity.

Integrated Life Sciences Building

The Integrated Life Sciences Building is a flagship building of the Fralin Life Science Institute, an investment institute committed to supporting research, education, and outreach in Virginia Tech's life sciences community.

Kelly Hall

Opened in 2009, Kelly Hall houses the Institute for Critical Technology and Applied Science, which supports and promotes cutting-edge research at the intersection of engineering, science, and medicine. The building includes engineering-led research laboratories, offices, and workspaces.

Marion duPont Equine Medical Center

The Marion duPont Scott Equine Medical Center is a premier, full-service equine hospital located in Leesburg, Virginia, and one of two hospitals of the Virginia-Maryland College of Veterinary Medicine. We offer advanced specialty care, 24-hour emergency treatment, and diagnostic services for all ages and breeds of horses. Our team of equine specialists in internal medicine, reproduction, sports medicine and rehabilitation, and surgery is committed to providing exceptional treatment for patients; superior service to clients; education for referring veterinarians, future veterinarians, and clients; and cutting-edge research to the equine industry.

Virginia-Maryland College of Veterinary Medicine

Established in 1978. The college is a leading biomedical teaching and research center and the in-state veterinary college for residents of Virginia and Maryland. Locations include the main campus in Blacksburg, Virginia, the Marion duPont Scott Equine Medical Center in Leesburg, Virginia, and the Gudelsky Veterinary Center in College Park, Maryland.

DEGREES OFFERED

IGEP Degree

Offered In (Leesburg, Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

Regenerative Medicine is not a degree-granting program.

REMOTE SENSING

Randolph Wynne, Program Director

Professors: Amos Abbott; Joseph Baker; William Hession; Richard Hirsh; Eric Patterson; John Ruohoniemi; Valerie Thomas; Layne Watson; Randolph Wynne;
Associate Professors: Scott Bailey; Xinwei Deng; Saul Halfon; Kevin Kochersberger; Klaus Moeltner; Yang Shao; Manoochehr Shirzaei;

Venkataramana Sridhar; Robert Thomas;

Assistant Professors: George Allen; Elinor Benami; Rebecca Cockrum; Anuj Karpatne;

Virginia Tech National Security Institute: Eric Patterson;

Research Assistant Professors: Bharat Simha Reddy Kunduri;

Randolph Wynne: wynne@vt.edu

Valerie Thomas: thomasv@vt.edu

Joseph Baker: jo.baker@vt.edu

Graduate Site: https://www.rsigep.frec.vt.edu

Remote sensing provides technical and methodological approaches to holistically study human activities that have an impact on the Earth's physical processes. Ever-increasing natural and anthropogenic influences on the earth system necessitate the formation of a cadre of scientists well-trained to fully exploit the terabytes of information available daily from air- and space-borne sensors. While the information resulting from analysis of these data is, by itself, policy relevant, only by combining the information available from remote sensing with the knowledge, approaches, and analytical tools of the social sciences can complex issues at the interface of science and society be addressed. Further, remote sensing itself engenders a variety of social and policy questions, ranging from personal privacy to the social and cultural change that inevitably results from the wide adoption of transforming technology.The goal of this program is to provide fully integrated educational experiences that will strengthen and enhance the ability of our graduates to address interdisciplinary challenges facing remote sensing scientists in today's workplace. We do this by incorporating all aspects of remote sensing, including science, engineering, theory, data analysis, applications, and policy.Our internationally-recognized faculty members span 5 colleges and 13 departments at Virginia Tech:College of Engineering Aerospace and Ocean Engineering (AOE) Biological Systems Engineering (BSE) Computer Science (CS) Electrical and Computer Engineering (ECE) Mechanical Engineering (ME) College of Natural Resources and Environment Forest Resources and Environmental Conservation (FREC) Geography (GEOG) College of Agriculture and Life Sciences Agricultural and Applied Economics (AAEC) Biological Systems Engineering (BSE) College of Liberal Arts and Human Sciences History (HIST) Science and Technology Studies (STS) College of Science Geosciences (GEOS) Biological Sciences (BIOL) Statistics (STAT)

SPECIAL FACILITIES

Advanced Research Computing

Advanced Research Computing (ARC) delivers a comprehensive ecosystem consisting of advanced computational systems, large-scale data storage, visualization facilities, software, and consulting services.

Center for Environmental Analytics and Remote Sensing

The CEARS laboratory is equipped with 22 networked (1 Gbit) precision workstations (15 Quad core Xeon with 64 Gb ram, 7 Six core Xeon with 128 Gb ram) a high end large format printer, and a complete suite of image processing (ENVI, ERDAS Imagine) and associated software, including compilers (IDL, Fortran), numerical scripting environments (Matlab, Julia, Python), statistical packages (R, SAS, Minitab, Salford Predictive Miner), structure from motion photogrammetric processing (DroneDeploy, Pix4D) and GIS (QGIS and ESRI products). There is over 100 TB of local networked attached storage (backed up daily). Capability for measuring and integrating in situ and unmanned airborne measurements is provided by UAS lidar (YellowScan; joint with BSE), full range ASD spectroradiometers, roving GPS base stations, and a wide variety of commercial off the shelf sUASs.

Space@VT

Space@VT focuses on research investigations of the science, technological impact, and utilization of the geo-space environment. The goal of Space@VT is to develop a holistic approach to such research utilizing theoretical and advanced computational modeling as well as the development of scientific instruments and space missions for experimental data acquisition and analysis. Research Facilites Global Navigation Satellite System GNSS Laboratory Space Systems Simulation Laboratory Aeronomy/Remote Sensing Laboratory Advanced Space Computation Laboratory SuperDARN Space Weather Radar Facility Space Plasma Chamber

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

iBT: (90.0)

GRE

General: Verbal, Quantitative, Analytical

The Interdisciplinary Graduate Education Program in Remote Sensing requires all students to be accepted by and enrolled in a home program in one of the following core participating departments/programs (colleges in parentheses): Aerospace and Ocean Engineering (Engineering) Agricultural and Applied Economics (Agriculture and Life Sciences) Biological Sciences (Science) Biological Systems Engineering (Agriculture and Life Sciences, Engineering) Computer Science (Engineering) Electrical and Computer Engineering (Engineering) Forest Resources and Environmental Conservation (Natural Resources and Environment) Geosciences (Science) Geospatial and Environmental Analysis (Natural Resources and Environment) Mechanical Engineering (Engineering) Science and Technology Studies (Liberal Arts and Human Sciences) Statistics (Science) It is essential that students applying to the Remote Sensing IGEP designate their desired home program on their application so that the materials can be appropriately routed for joint evaluation. In addition to participating in IGEP-specific events and meetings, enrolled students must meet all requirements of their home program and the Remote Sensing Certificate, plus enroll in either GRAD 5134 (Interdisciplinary Research in Remote Sensing) or the Interdisciplinary Seminar in Remote Sensing (FOR/GEOG 5104 or equivalent) if offered, each semester in which they are enrolled on campus. A lab exchange is required, either on- or off-campus. Most students elect the off-campus option with federal scientists at a national lab, NASA Center, or other agencies. Co-chairing of advisory committees is considered to be the norm; exceptions must be granted by the program director in consultation with the major professor and home department.

RHETORIC AND WRITING

Kelly Pender, Chair

Professors: Bruce McComiskey; Derek Mueller; Kelly Pender; Katrina Powell;

Associate Professors: James Dubinsky;

Assistant Professors: Sweta Baniya; Carolyn Commer; Sherri Craig; Julie Gerdes; Cana Itchuaqiyaq; Chris Lindgren; Megan Weaver; Travis Webster;

Graduate Contact: mtrimmer@vt.edu

Graduate Site: https://liberalarts.vt.edu/academics/graduate-programs/phd-in-rhetoric-and-writing.html

The PhD Program in Rhetoric and Writing at Virginia Tech focuses on rhetoric in society. We study language use and rhetorical activity in public, academic, corporate, and governmental settings in a collective effort to engage pressing social and cultural issues through academic discourse, public policy, and community outreach. As faculty and students at a land-grant university recognizing the history of our university's location upon indigenous lands, we engage in rhetoric and writing research that contributes to social progress, examines how literate practices create, circulate, and prioritize societal values and the public policies based on those values, and examines how rhetoric and writing empower and control access to power in these social systems. Our collective research agendas address rhetorical and social problems in such areas as: science, medicine, and technology digital texts and publishing diversity and difference the environment scholarly inquiry health and disability education civic engagement globalized communication and commerce displacement and resettlement

SPECIAL FACILITIES

Center for Rhetoric in Society At the Center for Rhetoric in Society, we examine multiple rhetorics, bridging academic and public discourses to enact engagement and social change. Our mission is to investigate language use through rhetorical and narrative analysis to understand significant social problems. Graduate research assistants participate in all aspects of the Center, including grant writing, assisting faculty in research, organizing research symposia, and writing scholarly articles. Seewww.rhetoric.english.vt.edu/ for additional information.

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DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

Degree requirements will include 60 hours of graduate coursework past the bachelor's degree plus 30 hours of research and dissertation. Of those 60 hours of coursework, up to 30 may be transferred from an appropriate Master's degree. Because rhetoric and writing are inherently interdisciplinary subjects, this program invites students to complete some coursework in related fields such as Language and Literature, Communication, Political Science, Human-Computer Interaction, Women's and Gender Studies, Science and Technology in Society, ASPECT, and Engineering Education, as well as courses in preparing the future professoriate offered by the Virginia Tech Graduate School.http://www.liberalarts.vt.edu/academics/graduate-programs/doctoral-programs-list/phd-in-rhetoric-and-writing.html

SCIENCE AND TECHNOLOGY STUDIES

Saul Halfon, Chair

Emeriti Faculty: Gary Downey;

Professors: Janet Abbate; Barbara Allen;

Associate Professors: Daniel Breslau; James Collier; Saul Halfon; Ashley Heflin; Rebecca Hester; Christine Labuski; Philip Olson; Sonja Schmid; Lee Vinsel; Matthew Wisnioski;

Assistant Professors: John Aggrey; Monamie Haines; Fabian Prieto-Nanez; Fernanda Ribeiro Rosa;

Alumni Distinguished Professor: Gary Downey;

Collegiate Assistant Professors: Cora Olson;

Collegiate Associate Professors: Matthew Goodrum;

General Contact: slusserc@vt.edu

Student Handbook: http://www.sts.vt.edu

Science and Technology Studies explores the relationship between science, technology, and society using a variety of disciplinary and interdisciplinary approaches. Research in STS analyzes how society affects the development and implementation of scientific, technological, and medical knowledges and practices and how scientific, technological, and medical pursuits affect society. The research and scholarly interests of STS faculty cross a wide range of disciplinary boundaries: some rely on fieldwork, others are immersed in historical or governmental archival research, while others develop social and conceptual analyses to answer theoretical or ethical questions. Graduate students in STS come from a wide range of backgrounds including the natural and physical sciences, engineering, numerous professional disciplines, liberal arts and humanities, history, anthropology, sociology, political science, and philosophy. Graduates emerge with an ability to identify and examine the conceptual, social, cultural, historical, and policy dimensions of science and technology.Courses leading to an M.S. or a Ph.D. in STS are available at two sites, Virginia Tech's main campus in Blacksburg and the National Capitol Region (NCR) in the greater D.C. metro area.

SPECIAL FACILITIES

Lane Hall. The STS administrative offices are located in 122 Lane Hall. Individual faculty offices are located in Lane Hall as well as other buildings on campus. The National Capital Region is located at 2054 Haycock Road, Falls Church, VA.

Lane Hall

The STS administrative offices are located in 122 Lane Hall. Individual faculty offices are located in Lane Hall as well as other buildings on campus. The National Capital Region is located at 2054 Haycock Road, Falls Church, VA.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (577.0)

iBT: (90.0)

Computer: (233.0)

MS course requirements can be found on this website: https://drive.google.com/file/d/0BwSZF3oYTnaBelpFV00tYk1XNE0/view PhD course requirements can be found on this website: https://drive.google.com/file/d/0BwSZF3oYTnaBNnhDWmNzN1N5Tjg/viewFor further information, contact Carol Sue Slusser at slusserc@vt.edu

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

GRE

General Test: Verbal, Quantitative, Analytical

MS course requirements can be found on this website: https://drive.google.com/file/d/0BwSZF3oYTnaBelpFV00tYk1XNE0/view PhD course requirements can be found on this website: https://drive.google.com/file/d/0BwSZF3oYTnaBNnhDWmNzN1N5Tjg/viewFor further information, contact Carol Sue Slusser at slusserc@vt.edu

GRADUATE COURSES (STS)

STS 5024:

Introduction to Science and Technology Studies

Intellectual and institutional history of the field. Key theories, methods, and domains of study. Relation among perspectives from contributing disciplines, and emerging interdisciplinary trends. Emphasis on both solid grounding through classic texts, and discussion of emergent research areas.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5104 (PSCI 5104) (SPIA 5104):

Policy Gateway: Policy and Decision Making in Scientific Domains

Key concepts in policy making, including policy analysis and decision making in complex social and technical settings. Policy process theories and evaluation tools. Concepts of governance including public values, ethics, and variable impacts across communities. Relationships among public policy decision processes and science, technology, and engineering, including disciplinary norms. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5105:

Contemporary Issues in Science and Technology Studies

Theoretical and methodological issues addressed in the interdisciplinary social study of contemporary science and technology. 5105: social studies of science; 5106: social studies of technology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5106:

Contemporary Issues in Science and Technology Studies

Theoretical and methodological issues addressed in the interdisciplinary social study of contemporary science and technology. 5105: social studies of science; 5106: social studies of technology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5124 (PSCI 5124) (SPIA 5124):

Decision Making, Reflective Practice, and Engagement in STEM-H Domains

In-depth case-based exploration of roles of science, technology, engineering, and mathematics in policy-making. Application of theories, concepts and practices for policy decision-making, including stakeholder engagement, human behavior, and organizational development. Critical examination of ethics, and fostering of reflective practice. Implications of big data and modeling in decision-making. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5134 (WGS 5124):

Gender, Bodies, & Technology

Intersections of gender, bodies, and technologies in multiple contexts and across disciplines. Technology in individual lives and the gendered discourses surrounding bodies and technologies. Feminist and queer theories of technoscience and the impact of technologies on gendered bodies. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5154 (PSCI 5154) (SPIA 5154):

Science, Technology, and Engineering in Policy Seminar

Seminar for Science, Technology, and Engineering in Policy (STEP) program students. Presentation of research on the intersections of science, technology, engineering, math, and health (STEM-H), public policy, and ethics. Professional development. Research resources and tools. Project management and funding opportunities. Publishing standards and processes across disciplines. STEM-H and policy practitioner engagement. Multidisciplinary communication. May be repeated up to six times, as seminar and presentation topics will change each semester. Pass/Fail only. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5205 (HIST 5205):

Main Themes in the History of Science and Technology

Methods and concepts in the history of science and technology. 5205: research methods, interpretive approaches, and contemporary issues in the history of science; 5206: research methods, interpretive approaches, and contemporary issues in the history of technology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5206 (HIST 5206):

Main Themes in the History of Science and Technology

Methods and concepts in the history of science and technology. 5205: research methods, interpretive approaches, and contemporary issues in the history of science; 5206: research methods, interpretive approaches, and contemporary issues in the history of technology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5284 (NSEG 5284) (SPIA 5284):

Nuclear Nonproliferation, Safeguards, and Security

Technical essentials, policy analysis, theoretical perspectives of nuclear energy and nuclear nonproliferation. Fundamentals of the nuclear fuel cycle, management of international safeguards, threat of nuclear terrorism, and challenges for global nuclear industry. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5305:

Main Themes in the Philosophy of Modern Science and Technology

Problems, literature, and schools in the philosophy of science and technology. 5305: explanation and confirmation; 5306: theory change.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): PHIL 3505

Corequisite(s):

STS 5306 (PHIL 5306):

Main Themes in the Philosophy of Modern Science and Technology

Problems, literature, and schools in the philosophy of science and technology. 5305: explanation and confirmation; 5306: theory change.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5364 (GIA 5364) (PSCI 5364):

Public Ecology

Examines policy developments and practices that move beyond the conceptual divisions and policy operations begun during the 1970s, which largely divided the more natural science- based environmental sciences from social science-based environmental based studies. Mixes the insights of life science, physical science, social science, applied humanities, and public policy into a cohesive conceptual and operational approach to environmental protection in the 21st century. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5404:

Science in Modern America

History of science connected to social and policy issues in modern America. Mutual influence between science and cultural factors such as race and gender, military and corporate funding, scientific communities and professionalization, and federal science policy. Diverse theoretical frameworks and research methods for writing about history of science. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5424:

Topics in Science and Technology Studies

Variable topics in science and technology studies such as role of values in science and technology, risk assessment, and past and present relations of religion to science and technology. May be repeated to a maximum of 6 hours.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5444:

Issues in Bioethics

Identification and analysis of ethical issues arising in basic and applied biological, medical, environmental, ecological, and energy studies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5514:

Research Designs and Practices for Sts

Examines research designs and practices that uncover historical relationships between knowledge contents and social dimensions of science, technology, and medicine. Includes archival research, archaeology of instruments and physical spaces, interviewing for knowledge content, logical and conceptual analysis, participant observation, questionnaires, and proposal preparation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5614 (PAPA 5614):

Introduction to Science and Technology Policy

Strategies for science and technology policy; science education; scientific and technical information for societal uses; government and public policy; resource allocation; economy and global exchanges of science and technology; approaches to policy evaluation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

STS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

STS 6234:

Advanced Topics in the History of Modern Science, Technology and Medicine

Variable topics in history of science, technology, and medicine after 1800, such as the atomic age; space science; science, technology, and institutions; scientific and technological medicine; and environmental history. May be repeated with a different topic for a maximum of 6 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 6244:

History, Culture, and Politics of the Internet

Explores a variety of social factors, past and present, that have affected the way we make, use, and think about computers and the Internet. Begins with the origins of the Internet and the people who shape this technology, from military strategists to hackers. Examines the ways diverse groups interact and build communities online and how cultural norms about race and gender shape the ways we participate in the world of computing. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 6534:

Advanced Topics in Cultural Studies of STEM-H

Variable topics in cultural studies of science, technology, engineering, mathematics, and health. May include theories of language and science, popular and public knowledges, cultural performances around science and technology, conceptions of health and the body, cultures of quantification, technology and identity, hierarchies and diversity in science and technology, and cross-cultural comparisons. May be repeated with different content up to a maximum of 12 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STS 6564 (SPIA 6564):

Risk in Contemporary Culture

Conceptual perspectives on social and cultural studies of risk. Qualitative theories and tools for analyzing a wide range of risks in contemporary culture. Definitions of risk as opposed to concepts such as danger, hazard, and uncertainty. Perception of risk and selective bias in risk perception. Efficiency, objectivity, and morality as factors influencing

risk assessment and risk management, and affective definitions of safety and reliability. Role of expertise, trust, and communication in risk regulation. Democratic policy instruments to facilitate stable, legitimate decisions about what risks to take or avoid in contemporary societies. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

STS 6614:

Advanced Topics in Technology Studies

Variable topics in technology studies, including development and structure of knowledge in technology and engineering, social construction of technology, knowledge and power in technology, gender and technology, engineering in society, human/nonhuman relations in technology. May be repeated with a different topic for a maximum of 6 credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

STS 6664:

Advanced Topics in Science and Technology Policy

Variable topics in science and technology policy. Includes advanced study of science, technology, and economy; science, technology, and power; strategies for research and development policy --public and private sector; transfer of technology; technological forecasting; government regulation and responses; science policy assumptions and challenges, specialist knowledge and expertise; state and academic knowledge production; issues of race, class, gender, and national identity in policy work. May be repeated with a different topic for a maximum of 6 credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

STS 6674:

Advanced Topics in Alternate Perspectives On Science, Technology & Medicine

Variable topics in alternate perspectives. Includes science from scientists perspectives, indigenous knowledge forms, alternative medicine, New Age science, cyborg theorizing, heterodox perspectives. May be repeated with a different topic for a maximum of 6 credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

STS 6984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

STS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

STATISTICS

David Higdon, Head

Professors: Ronald Fricker; Robert Gramacy; Feng Guo; David Higdon; Ina Hoeschele; Yili Hong; John Morgan; Eric Smith; Gordon Vining;
Associate Professors: Xinwei Deng; Christopher Franck; Leanna House; Leah Johnson; Scott Leman; George Terrell; Xiaowei Wu; Hongxiao Zhu;
Assistant Professors: Jyotishka Datta; Meimei Liu; Xin Xing;
Research Assistant Professors: Allison Tegge;
Associate Professor of Practice: Angela Patterson; Jennifer Van Mullekom;
Professor of Practice: Frederick Faltin; Alexandra Hanlon; Thomas Woteki;
Research Associate Professors: Laura Freeman;
Collegiate Associate Professors: Anne Driscoll; Jane Robertson Evia;
Collegiate Assistant Professors: Christian Lucero; Hamdy Mahmoud; Sierra Merkes;

Graduate Contact: chconne1@vt.edu

Director of Graduate Programs: leman@vt.edu

Graduate Site:

https://www.stat.vt.edu/content/stat_vt_edu/en/academics/graduate.html

Student Handbook: https://www.stat.vt.edu/academics/graduate/graduate-handbook.html

Founded in 1949, the Department of Statistics at Virginia Tech is the third oldest in the nation. Our program specializes in training students in statistical theory balanced with extensive applications including practical experience via the Statistical Applications and Innovations Group (SAIG). Over 875 master's degrees and 368 doctoral degrees have been awarded by the department. The 18-month master's program is a model of the time-efficient education of statisticians. The doctoral program includes specialized tracks in traditional and industrial statistics, bioinformatics, computational statistics (data analytics), and environmetrics.

SPECIAL FACILITIES

Through the Statistical Applications and Innovations Group (SAIG), students in cooperation with faculty members become involved in on-campus collaboration activities. M.S. students are required to participate in statistical collaboration within SAIG for at least one semester and Ph.D. students for at least three semesters. The department has several laboratories housing state-of-the-art Linux and PC networks. Students have access to these for collaboration, course work, and research. Students gain extensive experience with modern statistical software for experimental design, data management and analysis, and computer programming for statistical purposes.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal (150.0), Quantitative (160.0), Analytical (3.0)

The M.S. plan of study requires 34 semester hours of work, of which 32 semester hours must be taken within the department. Additional courses rounding out a plan of study may be taken at the graduate level in applied or theoretical statistics, mathematics, or in approved areas of application. The department offers thesis and non-thesis options for the MS degree. Each student must pass a qualifying examination after completing the core courses and a final oral examination after completing the plan of study.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (90.0)

GRE

General Test: Verbal (150.0), Quantitative (160.0), Analytical (3.0)

The Ph.D. plan of study requires a minimum of 90 semester hours of work beyond the baccalaureate, including at least 48 semester hours of coursework and at least 30 semester hours of research toward the dissertation. In addition to the core courses for the M.S. (or equivalent courses if a student enters the program with advanced standing from another university), the candidate for the Ph.D. must take four Ph.D. level courses including at least one of Measure and Probability (STAT 6105) or Advanced Topics in Statistical Inference (STAT 6114). Each candidate for the Ph.D. must pass the qualifying examination at the Ph.D. level. Flexibility is provided to the graduate program through the following Ph.D. areas of concentration: General Statistical Methodology and Theory; Biostatistics/Bioinformatics; Computational Statistics; Environmental Statistics; Business, Government and Industrial (BIG) Statistics, and even Sports Analytics. The General Statistical Methodology and Theory area of concentration encompasses the general pursuit of research in statistical theory and methods, allowing considerable freedom in choice of coursework within and outside the department. The Biostatistics/Bioinformatics, Computational, Environmental, BIG, and Sports Analytics areas of concentration offer more specialized statistical training geared toward application areas in which the department has particular expertise. These latter areas of concentration require more specialized coursework and research focus to be decided by the student and her/his advisory committee.

GRADUATE COURSES (STAT)

STAT 5014:

Introduction to Statistical Program Packages

Introduction to computing facilities (mainframe and microcomputers), conversational monitoring system (CMS), and statistical program computer packages. Restricted to Statistics majors.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): null null

STAT 5024:

Effective Communication in Statistical Consulting

Communication skills necessary to be effective interdisciplinary statistical collaborators. Explaining and presenting statistical concepts to a non-statistical audience, helping scientists answer their research questions, and managing an effective statistical collaboration meeting. Co: 5204 or 5616.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (STAT 5034, STAT 5044) OR STAT 5615

Corequisite(s): null null

STAT 5034:

Inference Fundamentals with Applications to Categorical Data

Fundamental concepts in statistical inference and related methods: point estimation, interval estimation, hypothesis testing, permutation, and resampling-based methods. Emphasizes use of R programming package, visualizing data, computation and interpretation of effect sizes, statistical simulation to compare the performance of available methods, role of sample size in statistical analysis, contingency tables, and use of model contrasts to assess specific hypotheses in the context of larger models.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): STAT 5014, STAT 5044

STAT 5044:

Regression and Analysis of Variance

Principles and methods of data analysis employing linear models for continuous response variables. Topics include both classical descriptive measures and modern computer-based techniques for data visualization; simple, multiple and weighted regression; analysis of variance for one-way and higher-way classifications; fixed, mixed, and random effects models; analysis of covariance; detection and correction of modeling flaws; statistical power.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5615, STAT 4584 OR MATH 4584

Corequisite(s): STAT 5014

STAT 5054:

Introduction to Statistical Computing

Introduction to modern programming packages for data analysis. Basics of coding, language syntax, and statistical functionality to read in raw data files and data sets, subset data, create variables, and recode data. Summaries in the form of tables and graphs. Data analysis using standard statistical methods and data management and analysis of large data sets. Parallel computing. Applied data analysis is emphasized rather than statistical theory. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5104:

Probability and Distribution Theory

Fundamental concepts of probability, random variables and their distributions, functions of random variables, mathematical expectations, and stochastic convergence.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): MATH 4526

Corequisite(s):

STAT 5105G:

Advanced Theoretical Statistics

5105G: Probability theory, counting techniques, conditional probability; random variables, moments; moment generating functions; multivariate distributions; transformations of random variables; order statistics. 5106G: Convergence of sequences of random variables; central limit theorem; methods of estimation; hypothesis testing; linear models; analysis of variance. Pre: 5105G: Graduate Standing; 5106G: 5105G.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5106G:

Advanced Theoretical Statistics

5105G: Probability theory, counting techniques, conditional probability; random variables, moments; moment generating functions; multivariate distributions; transformations of random variables; order statistics. 5106G: Convergence of sequences of random variables; central limit theorem; methods of estimation; hypothesis testing; linear models; analysis of variance. Pre: 5105G: Graduate Standing; 5106G: 5105G.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5105G

Corequisite(s):

STAT 5114:

Statistical Inference

Decision theoretic formulation of statistical inference, concept and methods of point and confidence set estimation, notion and theory of hypothesis testing, relation between confidence set estimation and hypothesis testing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): STAT 5104

STAT 5124:

Linear Models Theory

A study of the theory underlying the general linear model and general linear hypothesis. Applications in linear regression (full rank) and analysis of variance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5114, MATH 5524

Corequisite(s):

STAT 5134 (SPIA 5134) (PSCI 5134):

Tools and Approaches for Policy-Making in STEM-H Domains

Techniques for translating theory-driven, qualitative concepts into quantitative data-focused modeling to address policy problems. Quantitative and computational tools including statistical inference and hypothesis testing, system dynamics, and economic analysis. Modeling paradigms and common challenges in modeling. Modern data analytic practices, including good collection, storage and visualization techniques. Problem definitions and application to real-world policy-related problems and implementation in modern software packages. Understanding complexity. Critical evaluation of challenges and common pitfalls in quantitative modeling. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5154:

Statistical Computing for Data Analytics

Computational techniques for advanced applied statistical analyses and machine learning methods. Project management for larger data projects including computational constraints, pitfalls, and techniques related to different data types. Advanced report generation across different media, efficient R programming, advanced statistical function writing, parallel statistical computing with R, handling missing data, numerical optimization methods, the EM algorithm, and Monte Carlo methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5054

Corequisite(s):

STAT 5204:

Experimental Design and Analysis I

Principles and concepts of experimental design; systematic overview and discussion of basic designs from the point of view of blocking, error reduction, and treatment structure; and development of analysis based on linear models.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5104 OR STAT 5616

Corequisite(s):

STAT 5204G:

Experimental Design: Concepts and Applications

Fundamental principles of designing and analyzing experiments with application to problems in various subject matter areas. Completely randomized, randomized complete block and Latin square designs, analysis of covariance, split-plot designs, factorial and fractional factorial designs, incomplete block designs, repeated measures, power and sample size, mean separation procedures.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5605 OR STAT 5615

Corequisite(s):

STAT 5214G:

Advanced Methods of Regression Analysis

Multiple regression including variable selection procedures; detection and effects of multicollinearity; identification and effects of influential observations; residual analysis; use of transformations. Non-linear regression, the use of indicator variables, and logistic regression. Use of SAS.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5605 OR STAT 5615

Corequisite(s):

STAT 5234:

Experimental Design for Data Science

Understanding data, data collection, and proper data analysis for knowledge discovery and decision-making. Randomization, replication, blocking, data quality evaluations (e.g., representativeness of training data), analysis quality assessment (e.g., robustness of the machine learning algorithm to representativeness of training data). Strengths and weaknesses of experimental designs for data science. Modern qualitative and quantitative techniques for constructing experimental designs and analyzing experimental data. Interpretation and reporting of results.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): (STAT 5615, STAT 5616) OR STAT 5525 OR CS 5525

Corequisite(s):

STAT 5314:

Monte Carlo Methods in Stats

Theoretical and applied aspects of simulation-based sampling methodology. Monte Carlo integration, importance sampling, Markov chain Monte Carlo, particle methods, Kalman filtering. Programming in Matlab, R, or SAS.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5114

Corequisite(s):

STAT 5364:

Hierarchical Modeling

Hierarchical modeling techniques as applied to assess data with atypical features, such as non-normal responses (e.g., binary, discrete survival, continuous mixtures), censored/missing observations, multivariate responses, repeated measures, and nested structures. Classical and Bayesian techniques for assessing models. Programming experience in R, S+, or Matlab required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5044, STAT 5104, STAT 5444

Corequisite(s):

STAT 5364G:

Advanced Statistical Genomics

Statistical methods for bioinformatics and genetic studies, with an emphasis on statistical analysis, assumptions and problem-solving. Topics include: basic concepts of genes and genomes, commonly used statistical methods for gene identification, association mapping and other related problems. Focus on statistical tools for gene expression studies and association studies, multiple comparison procedures, likelihood inference and preparation for advanced study in the areas of bioinformatics and statistical genetics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5616

Corequisite(s):

STAT 5374:

Statistical Epidemiology and Observation Studies

Statistical methodology for epidemiology and observational studies. Statistical evaluation and inference for risk and prevalence of population safety and disease risk factors. Epidemiology and observational study design. Emphasis on casual inference and statistical models. Pre: 5034 or 5124 or 5615.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5034 OR STAT 5124 OR STAT 5615

Corequisite(s):

STAT 5414:

Time Series Analysis I

Analysis of data when observations are not mutually independent, stationary and nonstationary time series, linear filtering, trend elimination, prediction, and applications in economics and engineering. Even years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5114

Corequisite(s):

STAT 5434:

Applied Stochastic Processes

Stochastic processes in statistical applications including Markov chains, Poisson processes, renewal processes, branching processes, random walks, martingales, Brownian motion and related stationary Gaussian processes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5104

Corequisite(s):

STAT 5444:

Bayesian Statistics

Introductory course of Bayesian statistics on basic concepts of probability, Bayesian inference of Normal, Binomial, Poisson, Uniform and other common distributions, selections of prior information, Bayesian decision theory, Bayesian analysis of regression and analysis of variance and Bayesian foundation. Even years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5114

Corequisite(s):

STAT 5444G:

Advanced Applied Bayesian Statistics

Bayesian methodology with emphasis on applied statistical problems: data displaying, prior distribution elicitation, posterior analysis, models for proportions, means and regression. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5454:

Reliability Theory

Basic concepts of lifetime distributions, types of censoring, inference procedures for exponential, Weibull and extreme value distributions, nonparametric estimation of survival function, kernel density estimation, accelerated life testing, and goodness of fit tests.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 4106

Corequisite(s):

STAT 5474 (ISE 5474):

Statistical Theory of Quality Control

Development of statistical concepts and theory underlying procedures used in quality control applications. Sampling inspection procedures, the sequential probability ratio test, continuous sampling procedures, process control procedures, and experimental design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5104, STAT 5114

Corequisite(s):

STAT 5484 (AAEC 5484):

Applied Economic Forecasting

Forecasting economic, agricultural and environmental data using basic linear and non-linear time series models. Emphasis on programming and computational implementation of time series model-selection techniques and practical applications. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5504:

Multivariate Statistical Methods

Methods of inference for multivariate distributions. Multivariate distributions, location and dispersion problems for one and two samples, multivariate analysis of variance, linear models, repeated measurements, inference for dispersion and association parameters, principal components, discriminant and cluster analysis, and simultaneous inference. R will be used.

Credit Hour(s): 3

Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): (STAT 5104 OR STAT 5616)
Corequisite(s):

STAT 5504G:

Advanced Applied Multivariate Analysis

Non-mathematical study of multivariate analysis. Multivariate analogs of uinivariate test and estimation procedures. Simultaneous inference procedures. Multivariate analysis of variance, repeated measures, inference for dispersion and association parameters, principle components analysis, discriminant analysis, cluster analysis.
Prerequisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5616 OR STAT 5606
Corequisite(s):

STAT 5514:

Regression Analysis

Classical and modern techniques in regression analysis. Use of modern regression techniques to diagnose collinearity, leverage, and outliers. Model discrimination using cross validation techniques. The study of transformations, biased estimation, and nonlinear regression.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5124 OR STAT 5616
Corequisite(s):

STAT 5514G:

Advanced Introduction to Categorial Data Analysis

Statistical approaches to analyze categorical data. Probability computation and distribution specification, interval estimation and hypothesis testing, formulating and fitting generalized linear models including logistic and Poisson regression, algorithms used for model fitting, variable selection, and classification trees and supervised learning. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

STAT 5525 (CS 5525):

Data Analytics

5525: Basic techniques in data analytics including the preparation and manipulation of data for analysis and the creation of data files from multiple and dissimilar sources. The data mining and knowledge discovery process. Overview of data mining algorithms in classification, clustering, association analysis, probabilistic modeling, and matrix decompositions. Detailed study of classification methods including tree-based methods, Bayesian methods, logistic regression, ensemble, bagging and boosting methods, neural network methods, use of support vectors and Bayesian networks. Detailed study of clustering methods including k-means, hierarchical and self-organizing map methods. Prerequisite: Graduate Standing required. 5526: Techniques in unsupervised and visualized learning in high dimension spaces. Theoretical, probabilistic, and applied aspects of data analytics. Methods include generalized linear models in high dimensional spaces, regularization, lasso and related methods, principal component regression (pca), tree methods, and random forests. Clustering methods including k-means, hierarchical clustering, biclustering, and model-based clustering will be thoroughly examined. Distance-based learning methods include multi dimensional scaling, the self organizing map, graphical/network models, and isomap. Supervised learning will consist of discriminant analyses, supervised pca, support vector machines, and kernel methods.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

STAT 5526 (CS 5526):

Data Analytics

5525: Basic techniques in data analytics including the preparation and manipulation of data for analysis and the creation of data files from multiple and dissimilar sources. The data mining and knowledge discovery process. Overview of data mining algorithms in classification, clustering, association analysis, probabilistic modeling, and matrix decompositions. Detailed study of classification methods including tree-based methods, Bayesian methods, logistic regression, ensemble, bagging and boosting methods, neural network methods, use of support vectors and Bayesian networks. Detailed study of clustering methods including k-means, hierarchical and self-organizing map methods. Prerequisite: Graduate Standing required. 5526: Techniques in unsupervised and visualized learning in high dimension spaces.

Theoretical, probabilistic, and applied aspects of data analytics. Methods include generalized linear models in high dimensional spaces, regularization, lasso and related methods, principal component regression (pca), tree methods, and random forests. Clustering methods including k-means, hierarchical clustering, biclustering, and model-based clustering will be thoroughly examined. Distance-based learning methods include multi dimensional scaling, the self organizing map, graphical/network models, and isomap. Supervised learning will consist of discriminant analyses, supervised pca, support vector machines, and kernel methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5525 OR CS 5525

Corequisite(s):

STAT 5544:

Spatial Statistics

Spatial data structures: geostatistical data, lattices and point patterns. Stationary and isotropic random fields. Autocorrelated data structures. Semivariogram estimation and spatial prediction for geostatistical data. Mapped and sampled point patterns. Regular, completely random and clustered point processes. Spatial regression and neighborhood analyses for data on lattices.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5124

Corequisite(s):

STAT 5554:

Functional Data Analysis

Functional summary statistics, phase-plane plots, functional principal component analysis, functional regression models, principal differential analysis, dynamic models, analysis of manifold data, topological data analysis, data analysis of complex objects.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5124, STAT 5114, STAT 5044

Corequisite(s):

STAT 5574:

Response Surface Design and Analysis I

Use of response surface analysis to design and analyze industrial experiments. First and second order models. First and second order experimental designs. Use of model diagnostics for finding optimum operating conditions. Even years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5204

Corequisite(s):

STAT 5594:

Topics in Biostatistics

Course with variable content; specialized application of statistical theory and methodology to biological and medical sciences; topics include bioassay, epidemiology, survival analysis, and statistical ecology. May be repeated for credit with different topics. Odd years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5114

Corequisite(s):

STAT 5605:

Biometry

5605: The normal distribution, estimation, hypothesis testing, simple linear regression, and one-way analysis of variance with applications to the biological sciences. 5606: Experimental design, nested and factorial analysis of variance, linear regression and correlation, and the use of SAS, with applications to the biological sciences.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5606:

Biometry

5605: The normal distribution, estimation, hypothesis testing, simple linear regression, and one-way analysis of variance with applications to the biological sciences. 5606: Experimental design, nested and factorial analysis of variance, linear regression and correlation, and the use of SAS, with applications to the biological sciences. Knowledge of CMS required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5615:

Statistics in Research

5615: Concepts in statistical inference, including basic probability, estimation, and test of hypothesis, point and interval estimation and inferences; categorical data analysis; simple linear regression; and one-way analysis of variance. 5616: Multiple linear regression; multi-way classification analysis of variance; randomized block designs; nested designs; and analysis of covariance. One year of Calculus. CMS.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5616:

Statistics in Research

5615: Concepts in statistical inference, including basic probability, estimation, and test of hypothesis, point and interval estimation and inferences; categorical data analysis; simple linear regression; and one-way analysis of variance. 5616: Multiple linear regression; multi-way classification analysis of variance; randomized block designs; nested designs; and analysis of covariance. One year of Calculus and knowledge of CMS required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5664:

Applied Statistical Time Series Analysis for Reseach Scientists

Applied course in time series analysis methods. Topics include regression analysis, detecting and addressing autocorrelation, modeling seasonal or cyclical trends, creating stationary time series, smoothing techniques, forecasting errors, and fitting autoregressive integrated moving average models.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5616 OR STAT 5606

Corequisite(s):

STAT 5684:

Survival Analysis

Models and methods for time-to-event data with focus on biological and biomedical applications. Topics includes types of censoring and truncation; likelihood construction; survival function estimation; nonparametric two or more samples tests; Cox semiparametric regression, time-dependent covariates; regression diagnostics; competing risks; frailty model. Pre-requisite: Working knowledge of statistical software.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5044, STAT 5104, STAT 5114

Corequisite(s):

STAT 5754:

Internship in Statistics

Full time, supervised internship experience at a company or government agency performing statistical analysis. May be repeated for a maximum of 3 hours toward an M.S. degree and 6 hours toward a Ph.D. degree. Graduate standing in statistics and permission of department required.

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5024

Corequisite(s):

STAT 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

STAT 5924:

Graduate Seminar

Special topics in statistical theory and applications. May be taken for credit two times (max. 2C).

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

Instruction Type(s): Independent Study, VI

Prerequisite(s):

Corequisite(s):

STAT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

STAT 6105:

Measure and Probability

Development of measure theoretic foundations of probability theory. 6105: sigma fields, probability, and general measures; random variables, measurability and distributions, integration, and expectation; product measures; Radon-Nikodym theorem and conditioning. 6106: Random variables and strong and weak laws of large numbers; characteristic functions, central limit theorem and martingales; stochastic processes and Brownian motion. 6105 partially duplicates Math 5225. Must be enrolled in PhD program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5104 OR MATH 4525

Corequisite(s):

STAT 6114:

Advanced Topics in Statistical Inference

Advanced course in the theory of inference for graduate students in statistics and other qualified graduate students. Develops foundations, sufficiency, information, estimation, hypothesis testing, invariance, and unbiasedness.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5114

Corequisite(s):

STAT 6344:

Modeling for High Dimensional and Sparse Data

Statistical methods and modern computational methods for analyzing high dimensional data and sparse data, methods applied to complex data structures in various fields (e.g., genomics, epidemiology, and data mining), screening tools and matrix approximation, modeling strategies for high dimensional sparse data (parametric, nonparametric, and semiparametric regression models), statistical inference, graphical modeling methods, signal approximation methods, method limitations, functional analysis, causal inference, and data integration.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5114, STAT 5514

Corequisite(s):

STAT 6424:

Multivariate Statistical Analysis

Foundations of multivariate analysis. Distribution theory of vectors and matrices, inequalities, limit theory, the structure of some multivariate

location-scale parameter families, derived distributions, invariant distributions, the principle of invariance in estimation and testing for multivariate location and scale parameters, and robust aspects of normal-theory multivariate procedures.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5504
Corequisite(s):

STAT 6474:

Adv Topics Bayesian Statistics

Advanced concepts and methods in Bayesian analysis, including specifying priors, large sample theory, adaptive rejection sampling, adaptive rejection metropolis Hastings sampling, reverse jump Markov Chain Monte Carlo, model selection, nonparametric and semiparametric Bayesian methods using nonparametric priors, and Bayesian survival models.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5114, STAT 5514, STAT 5444
Corequisite(s):

STAT 6494:

Advanced Topics in Mathematical Statistics

Advanced treatment beyond standard course offerings in topics such as theory of inference, nonparametrics, sequential analysis, and limit theory. May be repeated for credit with different topics.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5114
Corequisite(s):

STAT 6504:

Experimental Design and Analysis II

Theoretical treatment of construction and analysis of various types of incomplete block and factorial designs.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5124, STAT 5204
Corequisite(s):

STAT 6514:

Advanced Topics in Regression

Advanced notions in modern regression techniques and diagnostics. The underlying theory and concepts associated with estimation methods for handling collinearity. Theory behind modern criteria for selection of candidate models. The development of single and multiple outlier and influence diagnostics. Odd years.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5124, STAT 5514
Corequisite(s):

STAT 6544:

Surrogate Modeling

Statistical techniques at the interface between mathematical modeling via computer simulation, computer model meta-modeling (i.e., emulation/surrogate modeling), calibration to field data, and geometric and model-based sequential design, and Bayesian optimization. Historical literature, canoncial examples, and modern nonparametric methods like Gaussian processes. Computation and implementation, fidelity enhancements and approximate methods for big data. Real-world field experiments and computer model simulations from the physical and engineering sciences.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5044, STAT 5204, STAT 5304, STAT 5444
Corequisite(s):

STAT 6554:

Advanced Statistical Computing

A second course on statistical and scientific computing. Hands-on, statistical implementation leveraging modern desktop computing (multiple cores), cluster computing (multiple nodes) and distributed computing (hadoop/Amazon EC2) and the coming wave of exascale computing (GPU/TPU/Xeon Phi). Fundamentals of the Unix shell, manipulating data therein, compiling libraries with make, version control (e.g., Git), good habits/best practice with code development and data management. Using advanced R skills to design statistical applications and bind together other languages (e.g., C, C++, Fortran, awk, sed, Cuda, etc.), databases, computing architectures and interfaces to address statistical problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5054

Corequisite(s):

STAT 6564 (ECON 6564) (AAEC 6564):

Bayesian Econometric Analysis

Bayesian estimation of economic models, with focus on Gibbs sampling, hierarchical modeling, data augmentation, and model search. Strong emphasis on programming and computational implementation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 6574:

Response Surface Design and Analysis II

Advanced techniques and theory in response surface analysis and design. Robustness of designs. Thorough study of the notion of rotatability. Optimal design criteria and designs for estimating slopes of response surfaces. Mixture designs. Study of model misspecification. Even years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5574

Corequisite(s):

STAT 6634 (EDRE 6634):

Advanced Statistics for Education

Multiple regression procedures for analyzing data as applied in educational settings, including curvilinear regressions, dummy variables, multicollinearity, and introduction to path analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): STAT 5634

Corequisite(s):

STAT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

STAT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

SUSTAINABLE NANOTECHNOLOGY

Professors: Linsey Marr; Amy Pruden-Bagchi; Peter Vikesland;

Associate Professors: Guoliang Liu; Frederick Michel; Maren Roman; Liqing Zhang;

Assistant Professors: Wei Zhou;

Nick Prillaman Professor: Peter Vikesland;

Charles P . Lunsford Professor: Linsey Marr;

W. Thomas Rice Professor: Amy Pruden-Bagchi;

Associate Professor of Practice: Sean McGinnis;

Research Assistant Professors: Matthew Hull;

Research Scientists: Weinan Leng;

Peter Vikesland: pvikes@vt.edu

Graduate Site: http://www.sun.ictas.vt.edu

The focus of the SuN IGEP is to develop a new paradigm wherein the sustainability of a given nanotechnology is considered during its entire life cycle. The primary research goal of the SuN IGEP is to facilitate the incorporation of sustainable design concepts in the nanotechnology field. The sustainability of a particular technology is often an afterthought in the design process; however, because nanotechnology is still in its infancy there is significant potential to proactively direct the field towards sustainable design. The primary educational goal of the SuN IGEP is to produce doctoral graduates that have the skills and expertise to provide leadership in the interdisciplinary field of sustainable nanotechnologies. This IGEP builds upon the existing infrastructure of the ICTAS VTSuN Center of Excellence, the NSF/EPA supported Center for the Environmental Implications of Nanotechnology (CEINT), and the EIGER NSF IGERT and the Green Engineering programs at Virginia Tech. Collectively these interdisciplinary efforts provide the intellectual focus and background for our IGEP group.Colleges and Departments:College of Engineering Civil and Environmental Engineering Materials

Science and EngineeringCollege of Natural Resources and Environment Sustainable BiomaterialsCollege of Science Departments Geosciences ChemistryFor more information please contact Peter Vikesland, Principal Investigator, pvikes@vt.edu

SPECIAL FACILITIES
The SuN IGEP investigators maintain laboratories in each of their individual departments. Details about these laboratories can be found at the individual investigator websites. A summary of the VTSuN program may be found at the VTSuN website: http://www.sun.ictas.vt.edu

Kelly Hall Laboratories

The VTSuN IGEP maintains extensive laboratories within Kelly Hall. The instrumentation available in these labs is described on the VTSuN webpage.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

VT SuN is not a degree-granting program.

THEATRE ARTS

Jeffrey Loeffert, Head

Professors: Robert Leonard; Patricia Raun;

Associate Professors: John Ambrosone; Amanda Nelson;

Professor of Practice: Stacy Blackburn; Laura Copenhaver; Tyler Holland;

General Contact: theatreandcinema@vt.edu

Graduate Contact: jambroso@vt.edu

Graduate Site: https://sopa.vt.edu/future-students/graduate-programs.html

Virginia Tech's three-year MFA Program in Theatre is committed to a student's professional advancement and creative journey. Providing autonomy for self-discovery, the program prepares students through experiential learning reinforced by fundamental practices. We equip students with strong interpersonal communication skills for a range of collaborative environments. Core Values:• Mentorship• Collaboration• Commitment• ProficiencyProgram DescriptionThe foundation of this program lies in practical application centered in production experience and management of production processes. Each student, in agreement with her/his Principal Advisor and graduate committee, develops a personalized program over the course of three years that responds to the student's background, needs, and goals. Students work on productions and projects in our department, the Moss Arts Center, or with regional arts organizations, assuming a greater responsibility as they progress through the program. In the student's final year, they undertake an internship with a theatre company, arts organization, or specific artist, providing students with extended experience in the field.The program remains small by design, accepting only a few students each year, to allow maximum production opportunities for the M.F.A. student. Every student accepted into the program is awarded an assistantship and full tuition waiver.

SPECIAL FACILITIES
Production and teaching facilities are located on the Blacksburg campus, primarily in Henderson Hall, Theatre 101 - a LEED-certified facility, and the Studio and Haymarket Theatres located in the Squires Student Center. Construction on Theatre 101 and the renovation of Henderson Hall were completed in the fall of 2009.

Classrooms and Labs

The renovated Henderson Hall houses general and dedicated classrooms, faculty offices, and fully equipped specialty labs, including: a CAD computer lab with multiple stations, a lighting design lab, a model-building lab, and an A/V sound and visual media design lab. Graduate student offices also are in this building.

Performance Venues

The Studio Theatre is a 214-seat three quarter thrust/modified proscenium. It features outstanding lighting, sound, and video systems, with a trap below and flexible actor access surrounding the stage area. A dismountable second level gallery is a readily available addition to the performance space. Its location directly in front of the Scene Shop makes set construction and loading remarkably convenient. The Haymarket Theatre in Squires Student Center is a 485-seat traditional proscenium with continental seating and a 34-foot wide proscenium, lending to more traditional theatre works. It is fully equipped with sound, lighting, and fly systems.Theatre 101 is a state-of-the art teaching theatre space and classroom facility that opened in Fall 2009. It is a 42 x 42 square foot open space with a lighting grid at 18 feet above stage level. Audience risers and portable seating allow flexible staging configurations; a box office and dressing room add further support. This venue is used primarily for workshop productions directed by students and faculty and for occasional guest productions. The new facility has strong technical capability and a lobby front offering a public face to the campus and the town of Blacksburg.Moss Arts Center is a brand new multi-faceted facility that incorporates a performance hall, gallery spaces, ICAT labs and performance spaces, classrooms, and offices. The new center brings professional artists and companies from around the globe to the Virginia Tech campus and community.

Production Support Facilities

The department maintains a fully equipped Scene Shop and Costume Shop for the construction of sets and costumes. The Scene Shop is a 3500 square foot space with 20 feet of clear height and an accessible loading dock, located immediately adjacent to The Studio Theatre. The

Costume Shop is a 1200 square foot space featuring excellent resources for cutting, patterning, construction and finishing, fittings, and storage necessary for complete design and build of costumes and costume crafts. A Management Office provides support for promotion, publicity, front-of-house, and all management operations.

DEGREES OFFERED

MFA Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The foundation of this program lies in practical application centered in production experience and management of production processes. Each student, in agreement with her/his Principal Advisor and graduate committee, develops a personalized program over the course of three years that responds to the student's background, needs, and goals. Students work on productions and projects in our department, the Moss Arts Center, or with regional arts organizations, assuming a greater responsibility as they progress through the program. In the student’s final year, they undertake an internship with a theatre company, arts organization, or specific artist, providing students with extended experience in the field. During the three-year program, the student can expect to engage in a series of experiences, which typically include: 1. Studios, which are tutorial interactions between students and faculty, and small group. classes. These are usually based on projects or areas of study specific to the student’s program. 2. Graduate Seminar sequence in which students study a variety of performance texts and traditions, non-profit and commercial models of theatre making, research, writing, and producing. 3. Production involvement in which the student assumes major responsibilities in production and management activities in the department, at the Moss Arts Center, or in a local or. regional arts organization. 4. Field projects and/or external opportunities (of short duration) at professional venues or. organizations, when available and possible. 5. Regional and national conferences, productions, and workshops, when applicable. 6. Summer projects/work for continued professional growth and development. 7. Professional residency or internship. 8. Final project and report.

GRADUATE COURSES (TA)

TA 5015:

Graduate Seminar

Special topics in the theory and practice of theatre, current trends, and recent developments.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5016:

Graduate Seminar

Special topics in the theory and practice of theatre, current trends, and recent developments.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5315G:

Advanced Directing

Script analysis, theories, techniques, and practical applications of theatrical direction. Theories and aesthetics of directing, functions of the director, script analysis, basic principles and techniques of staging. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5415:

Production Studio I

Investigation of various fundamental production problems involving topic-oriented research, collaborative work, and individual projects. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5416:

Production Studio I

Iinvestigation of various fundamental production problems involving topic-oriented research, collaborative work, and individual projects. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5425:

Production Studio II

Investigation and experimentation with various advanced production problems involving topic-oriented research, collaborative work, and individual projects. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5426:

Production Studio II

Iinvestigation and experimentation with various advanced production problems involving topic-oriented research, collaborative work, and individual projects. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5435:

Production Studio III

Investigation of specific production problems requiring the application of professional competencies (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5436:

Production Studio III

Investigation of specific production problems requiring the application of professional competencies. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5504:

Topics in Theatrical Scenic Technology I

Topic-centered investigation in theatrical production process and management, or technical theatre design concepts. Examination of theories and practice through research, communication and collaborative practices. Theoretical examination and practical application of a range of approaches and trends in the field. May be repeated once for credit with different content, for a maximum of 6 credits. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5514:

Topics in Theatrical Scenic Technology II

Topic-centered investigation in structural design for the theatrical stage in either wood or steel. Mathematical examination of empirical techniques and methods through practical examples and the application of a range of common challenges in the field. May be repeated once for credit with different content, for a maximum of 6 credits. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5524:

Topics in Theatrical Scenic Technology III

Topic-centered investigation in the physics, equipment, and automation involved in mechanical design for the theatrical stage. Examination of common practices through research, mathematical application, and practical application. Characteristic investigation and practical application of a range of approaches and trends in the field. May be repeated twice (2 times) for credit with different content, for a maximum of 9 credits. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5534:

Topics in Theatrical Scenic Technology IV

Topic-centered investigation in drafting and geometry, and theatrical rigging. Examination of common drafting and rigging practices through examples, and practical application. Characteristic investigation and practical application of a range of approaches and trends in the field. May be repeated 1 time for credit with different content, for a maximum of 6 credits. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5614:

Topics in Art Leadership I

Topic-centered investigation in arts management, leadership, or advocacy. Examination of theories and practice through research, communication and collaborative practices. Theoretical examination and practical application of a range of approaches and trends in the field. May be repeated two times for credit with different content, for a maximum of 9 credits. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5616:

Arts Management Studio I

Topic-oriented investigation of various fundamental arts management problems involving research, collaborative work, and individual projects. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5624:

Topics in Art Leadership II

Topic-centered investigation in specialized areas of arts management: arts marketing, development (fundraising), or grant writing. Involves research, communication and collaborative practices, and individual projects. Theoretical examination and practical application of a range of approaches and trends in the field. May be repeated two times for credit with different content, for a maximum of 9 credits. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5625:

Arts Management Studio II

Topic-oriented investigation and experimentation with various advanced arts management problems involving research, collaborative work, and individual projects. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5626:

Arts Management Studio II

Topic-oriented investigation and experimentation with various advanced arts management problems involving research, collaborative work, and individual projects. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5634:

Topics in Art Leadership III

Topic-centered investigation in various areas of advanced arts management: human resources, financial management, or strategic management. Involves research, communication and collaborative practices, and individual projects. Theoretical examination and practical application of a range of approaches and trends in the field. May be repeated two times for credit with different content, for a maximum of 9 credits. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5635:

Arts Management Studio III

Topic/project-oriented investigation of specific arts management problems requiring the application of professional competencies. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5636:

Arts Management Studio III

Topic/project-oriented investigation of specific arts management problems requiring the application of professional competencies. (2H, 2C minimum; 6H, 6C maximum) each.

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5704:

Graduate Theatre Internship

Internship of one semester in production (technical theatre, design, or directing), child drama (theatre for youth or creative drama), or arts management (including stage management) with a professional theatre company or similar off-campus professional situation.

Credit Hour(s): 9

Lecture Hour(s):

Instruction Type(s): Lab

Instruction Type(s): Lab

Prerequisite(s):

Corequisite(s):

TA 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

Instruction Type(s): Research, Online Research

Prerequisite(s):

Corequisite(s):

TA 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

TA 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TA 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

TRANSLATIONAL BIOLOGY, MEDICINE, AND HEALTH

Michael Friedlander, Head

Professors: Michael Friedlander; Anthony LaMantia;

Associate Professors: John Chappell; Kathryn Hosig; Steven Poelzing; Eva Schmelz; James Smyth; Michelle Theus;

Assistant Professors: Irving Allen; Alexandra DiFeliceantonio; Shannon Farris;

Graduate Contact: guynn@vt.edu

Graduate Site: http://www.tbmh.vt.edu/

The TBMH program has been designed to help address a national need for accelerating the pace of translation of biomedical discoveries into diagnostics, treatments, and cures, as well as their effective implementation. Major national organizations, such as the National Institutes of Health, Association of American Medical Colleges, and the Federation of American Societies for Experimental Biology, have called for new approaches to train biomedical and health scientists to achieve this goal, recognizing that today's researchers must utilize interdisciplinary approaches, communicate across levels of inquiry, and be prepared for the diverse careers that drive today's biomedical research enterprise. Graduates of the TBMH program will be well prepared to take on these challenges and become tomorrow's scientific leaders. Through a combination of TBMH core and focus area-specific coursework, students will be trained to go deep at advanced levels in a particular area (just as in classic disciplines), but also to have the skills, confidence and intellectual breadth to identify today's pressing health issues, and develop them in the framework and context of greater needs. This includes recognizing the likelihood of the adoption and application of translational discoveries, their cost, delivery, and related policy issues. Students may specialize in in one of six focus areas: Cancer Tissue Engineering and Reparative Medicine Public Health Implementation Science Immunity and Infectious Disease Metabolic and Cardiovascular Science Neuroscience (Cognitive or Molecular) Regardless of the focus area in which the students specialize, all graduates of the TBMH program will be able to: Explain the stages of the translational research spectrum Evaluate how multiple complex cellular and molecular factors influence physiological systems Integrate and model the processes of healthful function across scales, from the molecular to the organismal, and the individual to the social network Evaluate and compare published claims for the capacity to prevent or alter trajectories of unhealthy biological processes through genetic, pharmacological, behavioral and health systems interventions Conceive new conceptual approaches or technological strategies for the identification and quantification of pathological processes, their prevention or treatment, and/or the effective implementation of such interventions. Demonstrate effective written and oral communication of scientific concepts and data in translational biology, medical and health research. Work collaboratively in an interdisciplinary environment, which may include basic scientists, translational scientists, clinicians, administrators, or policy makers. Identify career opportunities for biomedical and translational scientists, and conduct one's chosen professional activities in a responsible and ethical manner

SPECIAL FACILITIES

According to the National Science Foundation annual survey of over 900 institutions, Virginia Tech continues to rank in the top 5 percent of colleges and universities in research and development expenditures. The university received almost $300 million in grant awards in FY2012, and over $450 million in research expenditures over that same year. Virginia Tech is ideally positioned to train the next generation of translational scientists to fulfill the innovative, interdisciplinary, and collaborative research needs of the future, as it merges strengths in the life sciences, social sciences, bioinformatics, and engineering, with an expanding biomedical and health research enterprise. This includes a recent $150 million investment in the Virginia Tech Carilion School of Medicine and Research Institute, located in Roanoke, Virginia. Due to the interdisciplinary nature of the program and the diversity of the faculty mentors and instructors (including clinical faculty who will instruct in courses and participate in student thesis advisory committees), students will have access to a broad range of Virginia Tech's research and instructional facilities located in both Blacksburg and Roanoke. Participating colleges include: College of Agriculture and Life Sciences College of Engineering, including the Virginia Tech Wake Forest University School of Biomedical Engineering and Sciences College of Liberal Arts and Human Sciences College of Natural Resources and Environment College of Science College of Veterinary Medicine Virginia Tech Carilion School of Medicine Students have the opportunity to participate in research rotations with three different research groups before selecting a thesis mentor, and may select from participating faculty at Virginia Tech's facilities in Blacksburg or Roanoke. The two campuses are conveniently interconnected through a free university shuttle system with onboard wireless internet, as well as via the Smart Way Commuter Bus. Both locations also utilize state of the art interactive videoconferencing technology to assist with multi-site course instruction and student thesis committee meetings, as well as for transmitting visiting guest lectures and seminar series between campuses.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg, Roanoke)

Students pursuing a TBMH Ph.D. degree must earn a minimum of 100 credit hours beyond the baccalaureate, including 31 credits of core coursework, 6 credits of elective coursework, and 63 credits of research and dissertation. An M.S. degree is not required for admission to the program, though students with an M.S. are also eligible to apply. All coursework must be 5000-level and above. Students perform three research rotations before selecting a thesis mentor at the end of the second semester of study. Candidates are eligible for graduation upon successful completion of all core, elective, and research credits, as well as passing performance on the Qualifying Examination, Preliminary Examination (advancement to candidacy), and successful oral defense of a written dissertation. Course Requirements: All students will be required to take the following core classes (31 credits): TBMH 5004 Translational Biology, Medicine, and Health (8 credits) TBMH 50X4 Fundamentals in [Focus Area 1] (4 credits) TBMH 50X4 Fundamentals in [Focus Area 2] (4 credits) TBMH 5105 Professional Development and Ethics (2 credits) TBMH 5106 Professional Development and Ethics (2 credits) TBMH 5304 Research Experience in TBMH (2 x 3 credits = 6 credits) TBMH 5204 Seminar in Translational Biology, Medicine and Health (4 x 1 credits = 4 credits) TBMH 5404 Scientific Logic and Analysis (1 credit) In addition, students must take the following: Quantitative Elective (3 credits) Free Elective (3 credits) TBMH 7994 Research and Dissertation (63 credits)

Degree Concentrations:

Cancer

Students entering this focus area will have an interest in eliminating the suffering and death due to cancer, through research in cancer prevention, early diagnosis, and treatment interventions. Focus area-specific coursework will take an integrative, translational approach to all aspects of neoplastic disease, from its basis in molecular cell biology (including genetics, stem cells, invasion and metastasis, immune surveillance) to its diagnosis and treatment (biomarkers, drug design, screening, personalized medicine, surgical approaches), as well as its social, psychological, and economic consequences. Students will develop a solid foundation for pursuing interdisciplinary doctoral level research in cancer biology.

Tissue Engineering and Reparative Medicine (TERM)

Students entering this focus area will have an interest in promoting a better quality of life through research into the biomedical and behavioral components of development and aging, as well as cutting edge technologies and methodologies for improving health in cases of developmental or age-related disorders and injuries. This focus area will emphasize processes critical to human biology and well-being across the lifespan. Students will develop a strong understanding of critical genetic, cellular, molecular, physiological, environmental and psychological aspects of human development, and how these processes go awry with aging, in order to best address how to repair them. Students will learn about multiple systems and techniques (including regenerative medicine). Faculty from diverse departments will come together to instruct students on the biological, psychological, social, and public policy components of the development and aging populations, as well as state of the art reparative approaches. Graduates will be well prepared to carry out innovative, interdisciplinary research to address critical challenges facing our developing and aging populations.

Public Health Implementation Science (PHIM)

Public Health Implementation Science is an emerging field strongly endorsed by the National Institutes of Health, The Institute of Medicine, and The National Research Council. It is located at far end of the clinical translational continuum -- focused on scientific inquiry about the “uptake” of major medical and health discoveries by practitioners and policymakers and their impact on the well-being of individuals and communities. Historically, the lag time from discovery of a major efficacious treatment to its actual clinical implementation has been estimated as 17 years, and many highly efficacious, affordable treatments are being implemented improperly, incompletely, and/or inequitably, thus failing to realize the benefits anticipated. Above all, there is grave concern that the mega-investments in basic science and clinical research are not yielding their full impact. In a now-seminal New England Journal of Medicine article, Zerhouni (2005), then Director of the National Institutes of Health, called for corrective action by creating “a new, vital, and reinforced academic discipline and home for translational and clinical science — along with an explicit effort to maximize the effectiveness of NIH resources directed to this area of research — to ensure that extraordinary scientific advances of the past decade will be rapidly captured, translated, and disseminated for the benefit of all Americans.” Students in the Public Health Implementation Science focus area will learn the basic terminology and approaches from a range of specialty fields -- including health literacy, information dissemination, health systems research, public health, community-based participatory research, health economics, and health disparities research – and explicitly connect them to conduct implementation science. Students will engage in case studies from all of the major basic biology, medicine, and health fields to understand the pathway from discovery of efficacious treatments or preventive interventions to their extension to clinical practice and the measurement of patient-oriented outcomes.

Immunity and Infectious Disease

Students entering this focus area will have an interest in performing research towards the understanding, prevention, and treatment of infectious and immunologic diseases. Track-specific coursework will take an integrative, translational approach to all aspects of infectious disease. They will learn about and discuss contemporary and emerging pathogens (viral, bacterial, and other), the human immune response, the development and delivery of novel diagnostics and therapeutics, as well as the social, psychological, and economic consequences of infectious and immune diseases. Students will develop a professional level of expertise in immunity and infectious disease, and learn to apply this knowledge to carry out innovative and interdisciplinary research to advance disease prevention, diagnostics and treatment.

Metabolic and Cardiovascular Science

Students entering this focus area will have an interest in improving health and quality of life through research on cardiovascular and metabolic health. Students will develop a comprehensive understanding of metabolic and cardiovascular physiology, and their interrelationship. This will include topics such as principle energy systems, appetite and energy expenditure, and cardiovascular function and regulation. Similar to other focus areas in the program, they will perform extensive analysis of primary literature and case studies covering the epidemiology, pathophysiology, and socioeconomic impact of cardiometabolic diseases (such as diabetes, obesity, and heart disease) with an emphasis on the translation of basic scientific discoveries into practical applications.

Neuroscience

Students entering this focus area will have an interest in reducing the burden of neurological and mental health disorders through research. Students will develop an understanding of the normal biological processes that undergird healthy brain and cognitive function, the causes and mechanisms of dysregulation that lead to dysfunction, and current and evolving approaches to therapy and novel therapeutic development. They will explore the inter-relationships of these processes at multiple levels at the intersection of brain biology, behavior, cognition, medicine and health and develop a strong foundation for pursuing doctoral level research in the brain and cognitive sciences. Students can choose to focus in Cognititive Neuroscience or Molecular

Neuroscience.

MS Degree

Offered In (Blacksburg, Roanoke)

Students pursuing a TBMH M.S. degree must earn a minimum of 38 credit hours beyond the B. S. degree. Students will engage in research throughout both years in the program, while completing most of their core coursework by the end of year 1. Students will take an intensive “Gateway” course (TBMH 5004, 8 credits) in semester 1, where they will learn the fundamentals of biomedicine, physiological systems, and translational science. They will then select a focus area in semester 2 and take an equally intensive “Fundamentals” course (4 credits) covering in depth the fundamentals of that focus area, with heavy emphasis on translational exemplars and case studies. The six focus areas are: Neuroscience; Cancer; Health Implementation Science; Metabolic and Cardiovascular Science; Immunity and Infectious Disease; and Development, Aging, and Repair. Students will continue a core curriculum in parallel with their focus-area-specific coursework, which includes professional development, ethics, and statistics, as well as program retreats and presentations. In total, students will take 24 credits of core coursework, 3 credits quantitative requirement, and a minimum of 11 credits of thesis research. Course Requirements:All students will be required to take the following core classes (24 credits): TBMH 5004 Translational Biology, Medicine, and Health (8 credits) TBMH 50X4 Fundamentals in [Focus Area 1] (4 credits) TBMH 50X4 Fundamentals in [Focus Area 2] (4 credits) TBMH 5105 Professional Development and Ethics (2 credits) TBMH 5304 Research Experience in TBMH (2 x 3 credits = 6 credits) In addition, students must take the following: Quantitative Elective (3 credits) TBMH 5994 Research and Dissertation (11 credits)

Degree Concentrations:

Cancer

Students entering this focus area will have an interest in eliminating the suffering and death due to cancer, through research in cancer prevention, early diagnosis, and treatment interventions. Focus area-specific coursework will take an integrative, translational approach to all aspects of neoplastic disease, from its basis in molecular cell biology (including genetics, stem cells, invasion and metastasis, immune surveillance) to its diagnosis and treatment (biomarkers, drug design, screening, personalized medicine, surgical approaches), as well as its social, psychological, and economic consequences. Students will develop a solid foundation for pursuing interdisciplinary research in cancer biology.

Tissue Engineering and Reparative Medicine (TERM)

Students entering this focus area will have an interest in promoting a better quality of life through research into the biomedical and behavioral components of development and aging, as well as cutting edge technologies and methodologies for improving health in cases of developmental or age-related disorders and injuries. This focus area will emphasize processes critical to human biology and well-being across the lifespan. Students will develop a strong understanding of critical genetic, cellular, molecular, physiological, environmental and psychological aspects of human development, and how these processes go awry with aging, in order to best address how to repair them. Students will learn about multiple systems and techniques (including regenerative medicine). Faculty from diverse departments will come together to instruct students on the biological, psychological, social, and public policy components of the development and aging populations, as well as state of the art reparative approaches. Graduates will be well prepared to carry out innovative, interdisciplinary research to address critical challenges facing our developing and aging populations.

Public Health Implementation Science (PHIM)

Health Implementation Science is an emerging field strongly endorsed by the National Institutes of Health, The Institute of Medicine, and The National Research Council. It is located at far end of the clinical translational continuum -- focused on scientific inquiry about the “uptake” of major medical and health discoveries by practitioners and policymakers and their impact on the well-being of individuals and communities. Historically, the lag time from discovery of a major efficacious treatment to its actual clinical implementation has been estimated as 17 years, and many highly efficacious, affordable treatments are being implemented improperly, incompletely, and/or inequitably, thus failing to realize the benefits anticipated. Above all, there is grave concern that the mega-investments in basic science and clinical research are not yielding their full impact. In a now-seminal New England Journal of Medicine article, Zerhouni (2005), then Director of the National Institutes of Health, called for corrective action by creating “a new, vital, and reinforced academic discipline and home for translational and clinical science — along with an explicit effort to maximize the effectiveness of NIH resources directed to this area of research — to ensure that extraordinary scientific advances of the past decade will be rapidly captured, translated, and disseminated for the benefit of all Americans.” Students in the Health Implementation Science focus area will learn the basic terminology and approaches from a range of specialty fields -- including health literacy, information dissemination, health systems research, public health, community-based participatory research, health economics, and health disparities research – and explicitly connect them to conduct implementation science. Students will engage in case studies from all of the major basic biology, medicine, and health fields to understand the pathway from discovery of efficacious treatments or preventive interventions to their extension to clinical practice and the measurement of patient-oriented outcomes.

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Metabolic and Cardiovascular Science

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Neuroscience

Students entering this focus area will have an interest in reducing the burden of neurological and mental health disorders through research. Students will develop an understanding of the normal biological processes that undergird healthy brain and cognitive function, the causes and mechanisms of dysregulation that lead to dysfunction, and current and evolving approaches to therapy and novel therapeutic development. They will explore the inter-relationships of these processes at multiple levels at the intersection of brain biology, behavior, cognition, medicine and health and develop a strong foundation for pursuing doctoral level research in the brain and cognitive sciences.

GRADUATE COURSES (TBMH)

TBMH 5004:

Translational Biology, Medicine and Health

Processes underlying human health and disease and the context in which they occur. Normal vs. pathological lifespan trajectory of humans and animal models at the molecular, cellular, organ system, organismal, group and social levels. Homeostatic processes throughout lifes stages and the genetic, environmental, behavioral and social drivers and interactions that lead to pathological outcomes. Pre: Graduate standing.

Credit Hour(s): 8

Lecture Hour(s): 8

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

TBMH 5014:

Fundamentals in Molecular Brain Science

Fundamental and translational neuroscience across multiple levels of analysis including molecular, cellular, systems, and developmental neurobiology, as it relates to brain function in both normal and pathologic states. Impact of brain disease burden on individuals, families and society will be discussed.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004

Corequisite(s):

TBMH 5024:

Fundamentals of Cancer

Comprehensive survey of neoplastic diseases across scales: genetic, molecular, cellular, tissue, organism, society. Causes diagnosis and treatment of cancer. Social and economic aspects of cancer.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004

Corequisite(s):

TBMH 5034:

Fundamentals of Health Implementation Science

Analysis of research and strategies for translating major medical and health discoveries into effective treatment delivery with measurable outcomes at the individual, health systems, and population levels. Theories of health implementation, research design and methodology, health messaging, human behavior change, health care decision making, health literacy and disparities, community-based participatory research, patient-centered research, and health economics and policy. Research new approaches to improve health outcomes, health care quality, and costs related to recent therapeutic or preventative discoveries.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004

Corequisite(s):

TBMH 5044:

Fundamentals of Cardiovascular Science

Comprehensive survey of cardiac and vascular physiology, and their interrelationship. Epidemiology, pathophysiology, and socioeconomic impact of cardiometabolic diseases, with an emphasis on translating basic scientific discoveries into practical applications.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004

Corequisite(s):

TBMH 5054:

Fundamentals of Immunity and Infectious Disease

Comprehensive survey of human immunity, infectious agents and disease across scales: genetic, molecular, cellular, tissue, organism, society. Diagnosis, treatment, and prevention of infectious and immune diseases. Social and economic aspects of infectious disease and immunity.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004

Corequisite(s):

TBMH 5064:

Fundamentals of Tissue Engineering and Reparative Medicine

Comprehensive survey of pre-natal and post-natal development, aging, and repair mechanisms in different organ systems. Advances in basic research and clinical approach to developmental disorders, genetics, degenerative diseases and regenerative therapies, considered in the context of biomedical research, health care, environmental triggers, economic impact and in society at large.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004

Corequisite(s):

TBMH 5074:

Fundamentals of Cognitive Brain Science

Fundamental and translational neuroscience across multiple levels of analysis including cognitive, computational and systems level function, as well as individual and social cognition in normal and pathologic states. Impact of brain disease burden on individuals, families and society.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004

Corequisite(s):

TBMH 5105:

Professional Development and Ethics

5105: Ethical standards of science and ethical issues in translational, biomedical and health research. Responsible conduct of biomedical and health research. Collaborative research strategies. Impact of translational science on national and global issues. Pre: Graduate standing. 5106: Scientific communication and grantsmanship in translational, biomedical and health research. Intellectual property, regulations, and commercialization. Career paths in biomedical and health research. Curriculum vitae and individual career development.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s): TBMH 5004

TBMH 5106:

Professional Development and Ethics

5105: Ethical standards of science and ethical issues in translational, biomedical and health research. Responsible conduct of biomedical and health research. Collaborative research strategies. Impact of translational science on national and global issues. Pre: Graduate standing. 5106: Scientific communication and grantsmanship in translational, biomedical and health research. Intellectual property, regulations, and commercialization. Career paths in biomedical and health research. Curriculum vitae and individual career development.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5105

Corequisite(s):

TBMH 5204:

Seminar in Translational Biology, Medicine and Health

Weekly scientific research presentations from local and invited visiting scholars on current topics related to the biomedical, translational, and health sciences. Emerging technological and methodological trends.

Recent conceptual advances, their relevance across specializations, and broader societal impact. May be repeated for up to 4 credits. Pass/Fail Only. Co: 5004 on first enrollment.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s): null null

TBMH 5304:

Research Experience in Translational Biology, Medicine and Health

Research experience in biomedical, translational, and health sciences. Experimental design and methods, techniques and procedures, lab safety, data analysis and significance, data presentation, evaluation of research contributions and scientific literature. May be repeated for a maximum of 15 credits. Co: 5004 Translational Biology, Medicine and Health upon first enrollment.
Credit Hour(s): 3
Lecture Hour(s):
Instruction Type(s): Lab
Instruction Type(s): Lab
Prerequisite(s):
Corequisite(s): null null

TBMH 5404:

Scientific Logic & Analysis in Translational Biology, Medicine, and Healht

Scientific logic, hypothesis testing, study design, and evaluation of evidence in biomedical, translational, and health science research. Critical evaluation and discussion of primary research studies. Analysis of contemporary research problems and controversies, research design and methodology, and interdisciplinary scientific approaches in translational biology, medicine, and health research. Effective peer-review and its role in science.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):   TBMH 5004
Corequisite(s):

TBMH 5964:

Field Work/Practicum

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

TBMH 5974:

Independent Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study
Instruction Type(s): Independent Study
Prerequisite(s):
Corequisite(s):

TBMH 5984:

Special Study

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

TBMH 5994:

Research and Thesis

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

TBMH 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Research, Online Research
Instruction Type(s): Research, Online Research
Prerequisite(s):
Corequisite(s):

TRANSLATIONAL OBESITY RESEARCH

Professors: George Davis; Brenda Davy; Kevin Davy; Dawnine Larson-Meyer; Dongmin Liu; Jyoti Savla; Stella Volpe;

Associate Professors: Deborah Good; Eva Schmelz;

Assistant Professors: Julia Basso; Siobhan Craige; Alexandra DiFeliceantonio; Joshua Drake; Samantha Harden; Valisa Hedrick; Benjamin Katz; James Weger;

General Contact: kdavy@vt.edu

Graduate Site: http://interdisciplinary.graduateschool.vt.edu/tor

Obesity is one of the most complex public health problems facing the nation and world today. More than a third of Americans and over one billion people worldwide are obese. Significant progress has been made in basic science discoveries related to the regulation of energy balance and in identifying efficacious lifestyle and pharmacologic approaches to manage obesity under tightly controlled conditions in primarily academic healthcare settings. However, there is little information available regarding the clinical relevance of many basic science discoveries or in the translation of promising clinical interventions to evidenced-based practice. Furthermore, little progress has been made in implementing and disseminating effective obesity prevention and treatment programs on a broad scale to have a positive public health impact. Thus, innovative interdisciplinary graduate training programs are needed to equip the next generation of scientists with the skills and knowledge needed to tackle the complex societal problem of obesity. This Translational Obesity Research graduate training program organized through the Interdisciplinary Graduate Education Program (IGEP) will draw faculty and students from diverse disciplines together to form integrative research teams with a central focus on translational obesity research, spanning from "cells to society" (i.e., from basic science to practice, policy and practice implementation). Colleges and Departments:College of Agriculture and Life Science Human Nutrition, Foods and Exercise Agricultural and Applied Economics Biochemistry Food Science and TechnologyCollege of Liberal Arts and Human Sciences Human Development and Family Science College of Engineering Computer Science Industrial and Systems Engineering Virginia-Maryland College of Veterinary Medicine Biomedical Science and PathobiologyFor more information please contact: Kevin Davy, kdavy@vt.edu, Principal Investigator

SPECIAL FACILITIES

This is an interdisciplinary program and shares facilities among departments across campus.

Facilities

Facilities are utilized based on the department of the major advisor.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

Requirements may vary depending on department.

TRANSLATIONAL PLANT SCIENCE

Professors: Eric Beers; Glenda Gillaspy; Jason Holliday; John McDowell; Mohammad Saghai-Maroof; Birgit Scharf; David Schmale; Ann Stevens; Dorothea Tholl; Boris Vinatzer; James Westwood; Mark Williams; Brenda Winkel; Bingyu Zhao;

Associate Professors: Brian Badgley; Jacob Barney; Amy Brunner; Eva Colla'kova'; John Jelesko; Song Li; Guillaume Pilot; Xiaofeng Wang;

Assistant Professors: Bastiaan Bargmann; David Haak; Gota Morota; Susan Whitehead; Bo Zhang;

John M. McDowell: johnmcd@vt.edu

TPS Web Page: https://translationalplantsci.fralinlifesci.vt.edu/

Translational Plant Science (TPS) is the process through which knowledge from basic research on plant genetics and genomics is used to improve agricultural productivity. The central goals of the TPS program are to (1) create a new training model to prepare molecular plant scientists to function along the bench-to-marketplace pipeline; (2) catalyze interdisciplinary research to address challenges in food security, plants as biofactories, and biomass. Our Center (https://translationalplantsci.fralinlifesci.vt.edu) spans six departments and three colleges, and is designed to foster the mindsets and skills students need to link basic plant science with downstream applications, which include: a global perspective on the challenges and opportunities presented by plant diseases; the ability to frame novel, use-inspired research questions and to pursue the answers within interdisciplinary teams; an awareness of the social and economic impacts of agricultural biotechnologies and plant disease and the ability to engage the public in meaningful dialogue about these complex issues; the ability to function effectively in the diverse cultures of the professions outside of academia that play key roles in the translational plant science pipeline (e.g. business, regulation, policy). The Graduate Program in Translational Plant Sciences is an integral part of the TPSC. It allows students interested in pursuing a Ph.D. degree in this discipline to work in a wide variety of research areas ranging from plant genomics to disease resistance, metabolic engineering, bioproduction and bioprocessing, and forest biotechnology. TPS degree candidates who enroll in the program participate in several rotations through laboratories of interest. The program of study includes selections from a range of course offerings, tailored to the background and interests of each student. At the end of the first or second semester of enrollment, a permanent advisor is selected in whose laboratory the dissertation research will be conducted. The diversity in the TPS program is evident by looking at the federal agencies that fund them: National Science Foundation, United States Department of Agriculture, Department of Energy, and National Institute of Health. Moreover, many laboratories are also supported by various Virginia and US grower organizations and industry. Colleges and Departments:College of Agriculture and Life Sciences Animal and Poultry Science Biochemistry Biological Systems Engineering School of Plant and Environmental SciencesCollege of Science Biological SciencesCollege of Natural Resources and Environmental Sciences Forestry For more information please contact John McDowell, Principal Investigator, johnmcd@vt.edu

SPECIAL FACILITIES

A group of approximately thirty faculty and many more students in seven departments in the Colleges of Agriculture, Science, and Natural Resources use molecular approaches to understand how plants grow and interact with their environments. Most faculty are housed in Latham Hall. The physical proximity of the research groups enables students, post-docs and faculty to interact freely with one another. Regular activities and seminars enable all TPSC members to get together and exchange ideas and news, and build the community spirit the TPSC is renowned for. The William C. and Elizabeth H. Latham Agriculture and Natural Resources Building provides research and office spaces, a conference room, and a lounge for the College of Agriculture and Life Sciences and the College of Natural Resources and Environment. The building contains eight full-size growth chambers that are two stories tall and enable researchers to conduct research on life-size trees. Our researchers in seven core areas are working on finding answers to today's problems. http://www.latham.cals.vt.edu/index.html

Latham Hall

Many of the TPS faculty members are housed in Latham Hall. Opened in 2006, the five-floor, 85,000 sq. ft. building houses researchers from the College of Agriculture and Life Sciences, the College of Natural Resources and Environment, and the College of Science. Building equipment includes multiple reach-in growth chambers, eight walk-in growth chambers, an insectary, and resources supporting mass spectrometry and liquid chromatography. A 40-person seminar room, a conference room, and several smaller meeting rooms are available for researcher interaction and informal gatherings. John McDowell, a Professor of Plant Pathology, Physiology, and Weed Science (PPWS), is the Fralin Life Science Institute Principal Scientist responsible for the general oversight of the building and coordination. The Fralin Institute provides funds to seed new research initiative and for maintenance, repairs, and upgrades of common equipment.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

Minimum GPA from bachelor degree: 3.0 NO GRE requiredTOEFL Scores required: Paper-based 600 minimum Computer-based 250 minimum Internet Based TOEFL (IBT)100 minimum IELTS: Band 6.5 minimum

URBAN AND REGIONAL PLANNING

Todd Schenk, Chair

Emeriti Faculty: James Bohland; Charles Koebel; John Randolph;

Professors: Ralph Buehler; Ralph Hall; Thomas Sanchez; Max Stephenson;

Associate Professors: David Bieri; Margaret Cowell; Steven Hankey; Shalini Misra; Todd Schenk; Diane Zahm; Yang Zhang;

Assistant Professors: Theodore Lim; Paroma Wagle;

Professor of Practice: Shelley Mastran;

Graduate Contact: ralphbu@vt.edu

Graduate Contact: dzahm@vt.edu

Graduate Contact: tschenk@vt.edu

UAP Home: https://spia.vt.edu/programs/uap.html

Graduate Site: https://spia.vt.edu/degree-courses/graduate/murp.html

The Master of Urban and Regional Planning (MURP) program is a two-year (48 credit hour) interdisciplinary professional degree open to students from a wide variety of undergraduate fields. The program's mission is to prepare students to become professional planners who can address the economic, environmental and social consequences of growth and change; and to provide leadership in fostering a more just and sustainable world through our teaching, scholarship, and service.The required core courses provide a foundation of planning theories and skills and constitute approximately one-half of the MURP curriculum. The remaining credit hours are selected by students and their advisors to develop individualized areas of specialization using coursework from across the university. Graduates are able to assume professional responsibilities in a wide variety of positions in public service or in the private sector. The program is accredited by the Planning Accreditation Board.The UAP graduate program is offered in two locations: the main campus in Blacksburg and in Arlington (Washington, DC metro area).Rolling admissions are possible until 1 August for the fall semester and 1 January for the spring semester. The application deadline for full consideration for graduate assistantships is 1 March.

SPECIAL FACILITIES

Architecture Annex in Blacksburg and Virginia Tech Research Center (VTRC) 900 N. Glebe Road, Arlington, VA, Northern Capital Region (NCR).

Architecture Annex, Blacksburg

In Blacksburg the MURP degree is offered in the Architecture Annex. The Architecture Annex is the main administrative building for the School of Public and International Affairs. The building was erected in 1916 as Blacksburg High School. It includes a computer lab and classrooms with wi-fi and video-conferencing capabilities.

VTRC (Virginia Tech Research Center)

In the Washington, DC metro area, the MURP degree is offered at the Virginia Tech Research Center (VTRC) in Arlington, VA. The VTRC comprises a seven-floor, 144,000-square-foot LEED-certified facility, with direct fiber access to Internet 2 and multiple federal networks. High-performance connectivity links this research center to Virginia Tech's main campus in Blacksburg, as well as to other major universities. The network provides access to international peering points in New York, Chicago, Seattle, Los Angeles, and Florida, and the building includes a secure data center for high performance computing (HPC)-based research. All rooms have wi-fi, projection facilities, external phone line access, and video-conferencing capabilities—equipment available to support research includes an 18-seat networked computer laboratory. The VTRC represents the hub of Virginia Tech's research activities in the National Capital Region and has been designed to further the university's mission to expand its research portfolio and partnerships with corporate research entities, federal agencies, and other public and private-sector organizations. Other labs and centers housed at the VTRC include the Advanced Research Institute, Arlington Innovation Center for Health Research, Center for Energy and the Global Environment, Computational Bioinformatics and Bioimaging Laboratory, Crowd Intelligence Lab, Discovery Analytics Center, and the Hume Center for National Security and Technology.

DEGREES OFFERED

MURPL Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Original Test: (550.0)

IELTS: (6.5)

IBT Test: (90.0)

MURP students must take 48 credit hours of work, with a 3.0 GPA or better. These credit hours are divided into the planning "core" courses, plus the individualized area of specialization. The core requirements include: UAP 5014 Gateway to Planning UAP 5084 Collaborative Planning and Community Involvement UAP 5174 Planning Theory and History UAP 5224 Planning Methods and Technologies UAP 5234 Urban Economy, Equity, and Society UAP 5554 Land Use Law and Planning UAP 5125-5126 Planning Studio: Real World Problems and Solutions or UAP 5994 Research and Thesis Applying for Admission: Interested students should use Graduate School's on-line system to apply. The MURP program requires applicants to submit an on-line application form, application fee, official transcripts of previous academic work, personal statement, three (3) letters of recommendation, and resume. The program does not require GRE scores. All international applicants whose first language is not English must submit TOEFL scores (see http://graduateschool.vt.edu/applying for Graduate School requirements). Note that the Graduate School requires a minimum cumulative grade point average for admission of 3.0 or better. This requirement may be relaxed based on an applicant's professional experience and accomplishments. Advanced undergraduates may apply for early admission into the accelerated undergraduate/graduate degree program, the combined architecture program, or for dual enrollment status. Interested undergraduate students should meet with an academic advisor to determine eligibility. Please also see admissions information provided on the Graduate School website. Simultaneous degrees : MURP students have the ability to pursue simultaneous master's degrees in other departments. The student must apply and be accepted into both programs, have an approved plan of study for each degree, and submit an Application for Simultaneous Degrees to the Graduate School. Graduate Certificates : The Graduate School at Virginia Tech offers a wide array of graduate certificates that are available to MURP students. Many students use a certificate program as the foundation for an individualized area of specialization related to the MURP degree. Urban Affairs and Planning offers certificates in Economic Development, Global Planning and International Development, Urban Planning Analytics, Transportation Planning and Policy, and participates in several others (Social, Political, Ethical and Cultural Thought, or ASPECT; Geospatial Information Technology; Nonprofit and Nongovernmental Organization Management; Public and Nonprofit Financial Management; and Watershed Management). MURP students have completed certificates in a variety of other areas as well. More information on graduate certificates is available from the Graduate School.

GRADUATE COURSES (UAP)

UAP 5004 (GIA 5004):

Power and Policy in the US

Social science theory and research on the distribution of power in the US, especially as it shapes important national policy outcomes. Institutional and class bases of power will be examined, including membership on corporate boards and in policy-shaping think tanks. Implications for democracy in society will be drawn. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5014:

Gateway to Planning

Careers in planning in the public, private and non-profit sectors. Planning practice in different contexts and governance systems. Planning ethics, community and stakeholder engagement, social justice, and professional regulations. Social, physical, environmental, economic, and other dimensions of complex planning problems. Professional skill development, with a focus on written, oral, visual, and digital communication, including social media in planning. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5034 (PAPA 5034) (GIA 5034):

Democratic Governance in the Economy

Interplay between democratic politics upon economic relations, with special focus on the intellectual foundations of capitalist development and consequences of financial disruption to economic policy making. Evolution of state-market interactions and of global governance institutions. Case studies of financial crises and their political implications. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5064G:

Adv Pollution Cntrl Plan & Pol

Planning and policy aspects of managing residuals and environmental contaminants and their effects on human health and environmental quality. Technical and economic factors involved in management of water quality, air quality and solid and hazardous wastes, toxic substances, and noise. Implementation of pollution control legislation, policies, and programs at federal, state and local levels.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5074G:

Adv Comm Renewable Energy Sys

Critical review of energy issues from local to international including economic, environmental, and social dimensions. Introduction to energy science, engineering, and economics. Application of energy and economic analysis to efficient and renewable energy systems in buildings, electricity, and transportation. Review and assessment of energy planning and policies for efficient and renewable energy at the local, state, and national levels. Prerequisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5084:

Collaborative Planning and Community Involvement

Public participation in planning and decision-making. Deliberative democracy and citizen empowerment. Tools for and approaches to community involvement and alternative dispute resolution. Facilitation and engagement process design. Opportunities and challenges associated with engaging communities in planning and decision-making. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5104:

Urban and Regional Development Theory

An examination and critique of theories relating to socio-economic development and change at three major scales (international, national/regional, and intra-urban) and of theories relating to the linkages between the dominant processes operating at these major scales. Particular emphasis is given to the role of the state in urban and regional development.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5114:

Topics in Computer Applications in Urban Planning and Management

Topics course on the application of analytical techniques for understanding and addressing urban and regional planning and management problems. Identification of data sources, data collection options and data analysis. Topics include geographic information systems, computer coding, spatial analysis, modeling of complex systems, or decision modeling. May be repeated with different content for a maximum of 12 credit hours. (Variable credit. 1-3H, 1-3C). Pre: Graduate standing.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5124:

Urban and Regional Planning Studio

Application of planning strategies to solve urban problems encountered in professional practice. Includes methods and techniques for securing and analyzing relevant data; identifying goals and objectives; formulating proposals; formulating strategies to implement proposals; presentation of findings. May be repeated with a different studio application for a maximum of 6 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5125:

Planning Studio: Real World Problems and Solutions

5125: Individual and collaborative group work on a community client-based project. Project management. Problem identification, data collection and analysis, community/stakeholder engagement. Professional norms and practices. 5126: Data analysis and visualization. Proposal of potential solutions to client-based planning problem. Preparation of a written report. Oral presentation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): UAP 5014, UAP 5084, UAP 5174, UAP 5224, UAP 5234, UAP 5554

Corequisite(s):

UAP 5126:

Planning Studio: Real World Problems and Solutions

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): UAP 5125

Corequisite(s):

UAP 5134G:

Advanced Land Use and Environment: Planning and Policy

Environmental factors involved in land use planning and development, including topography, soils, geologic hazards, flooding, and storm water management, ecological features and visual quality. Techniques for conducting environmental land inventories and land use suitability analyses. Policies and programs to protect environmental quality in land use planning. Prerequisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5174:

Theory and Practice of Urban and Regional Planning

Key planning theories and the history of planning thought and planning practice. Critical perspectives on the challenges and issues facing contemporary planning practice. Milestone events, themes, and debates in the history of planning and their influence on current planning thought and practice. Subfields and specializations in urban planning. Ethical issues in planning. Effective communication tools and techniques. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5184:

Local Government Planning Management and Administration

Leadership best practices and the skills of the local government planning manager. Planning office organization and operations. Planning ethics and ethical leadership. Legislative, statutorial, and legal context for planning. Politics and planning. Visioning and goal setting. Developing partnerships and opportunities for collaboration. Stakeholder management and conflict resolution. Data, analytics, and information technology in planning. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5214:

Topics in Natural Resources and Natural Hazards Planning

Concepts, theory, and practice of resilience-based, climate- change integrated natural resources management and hazards planning. Effects of land, water, soil, and ecosystem management on quality of life for present and future generations. Natural resources and natural hazards

planning process and tools for local communities and policies at state and federal levels. May be repeated for a maximum of 9 credit hours. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5224:

Planning Methods and Technologies

Quantitative and qualitative methods pertaining to urban and regional planning and analysis; types of data, data sources and data preparation; survey research; technologies for urban planning and analysis; ethics in planning methods. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5234:

Urban Economy, Equity, & Society

Urban and regional political economy and finance. Interactions and effects of economic forces and political institutions on urban policy and governance, as well as physical and social infrastructure and inequities. Urban growth and change, institutions of local and federal government and governance, real estate markets, equity, and institutional access. Urban finance, taxation policy and local revenue sources. Pre: Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5244:

Multicultural

Examines the growing ethnic and demographic diversity of urban United States. Stresses theories and techniques that can be used to bring about more inclusive planning and public policies at all levels of government.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5264G:

Advanced Environmental Ethics and Policy

Issues in applied environmental ethics. Contributions of multi-cultural religious and spiritual traditions to contemporary perspectives on the human-nature relationship. Examination of selected issues in environmental ethics from utilitarian economic, deep ecology, and ecofeminist perspectives. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5274:

Comparative Social Movements

This course will investigate the forms of public protest that occur all over the world, with special attention to activism in poor nations and to the recent emergence of transnational movements. Also examines why and when governments repress social movements. Explores movements that are grounded in collective identities based in class, race/ethnicity, gender, religion, and culture. Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5304:

Land Use Planning

Procedures for: (1) identifying the type, magnitude, and locational characteristics of urban land uses; (2) making projections of future land use; and (3) preparation of land use plans.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5324:

Topics in Infrastructure Planning in Developing Countries

Introduction to infrastructure planning and development practices in developing countries. Study of practices to address the complex challenges facing many developing regions. The current state of practice for the provision of infrastructure services. Role of public/private local, regional, and national planning/development agencies and international organizations and groups. May be repeated with different topics for a maximum of 9 credits.
Credit Hour(s): 1 TO 3
Lecture Hour(s): 1 TO 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5354:
Charity, Philanthropy and Civil Society
This course treats the evolution of philanthropy and charity in the United States and abroad and introduces major issues and continuing concerns linked to the institutions engaged in these activities while exploring their ties to civil society. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5364:
Non-Governmental Organizations in International Development
Explores theory and cases of non-governmental organizations in international development. Analyzes various roles of NGOs, and their interactions with local communities, government agencies, international organizations, and private businesses. Examines tensions and collaborations between NGOs and other development actors, drawing from cases in environmental, health, and educational policy domains.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5414:
Natural Resources Planning Topics
The natural resource planning process as implemented by federal public lands and water resources agencies in the U.S. Public participation, environmental impact assessment, and resource evaluation methods used in planning and decision-making. Applications to resources planning in developing countries. May be repeated with different topics for a maximum of 9 credits. Graduate standing required.
Credit Hour(s): 1 TO 3
Lecture Hour(s): 1 TO 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5424:
Metropolitan Planning Topics
A topics course focusing on the methods and techniques of evaluating physical development needs of metropolitan areas their sub-areas. Emphasis on elements of land use, physical development needs, representation, and the role of comprehensive plans and implementing regulatory ordinances (zoning, land subdivision regulations, building codes, environmental regulations). May be repeated with a different topic for a maximum of 12 credits.
Credit Hour(s): 1 TO 3
Lecture Hour(s): 1 TO 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5434:
Urban Development Project Review Studio
A studio focusing on the theory, methods, and techniques of evaluating physical development projects. Emphasis on evaluation criteria implied in public policy, as expressed in comprehensive plans and implementing regulatory ordinances (zoning, land subdivision regulations, building codes, environmental regulations).
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5464 (GIA 5464):
Qualitative Research Methods in Global Studies
Examines the philosophies and procedures guiding various qualitative methods used in the social science fields, such as global studies, planning and policy. Exploration of alternative understandings of normal science and consideration of the merits of adopting qualitative research approaches to disciplined analysis, including ethical issues in research.

Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5484:

Advanced Urban Research Methodology

The various methodological approaches used in the fields of urban planning and in public policy to analyze causes of problems and thus suggest policy recommendations. Emphasis is on defining the research problem, developing an appropriate research design, data collection, and fundamental techniques of data analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5494:

Advanced Quantitative Techniques for Urban Research

Advanced quantitative techniques used in urban analysis. Application of the methods to situations encountered in urban planning, urban policy analysis, and urban management are stressed.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5504 (PSCI 5504) (GIA 5504):

Discourse Analysis

Examines the key theoretical sources and major practical applications of discourse analysis as a contemporary social science methodology. Origins, major variants, and critical uses of discourse analysis in cultural studies, semiotic methods, policy analysis, and organizational communication techniques also are considered. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5524 (GIA 5524):

Internat Development

Social and cultural factors in the development of societies, including the role of women in development. Contemporary developing countries, and historical material from developed countries; policy issues facing governments of developing countries and those interested in assisting their development.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5554:

Land Use Law & Planning

Fundamentals of law as it applies to the use of land, with a primary focus on its practice in the United States. Comparative land use law. Case law and statutory law briefing. Constitutional and statutory limitations on regulation; common law principles; traditional use-based zoning and zoning processes and documents; alternative approaches to planning and zoning such as smart growth techniques and form-based codes; and the relationship between land use regulation and urban/metropolitan issues, such as social segregation, sustainability, and environmental justice. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5564:

Information Technology, Society, and Public Policy

Social impacts of new and emerging information technologies from a public policy perspective. Technical nature of IT and influences of IT on four core dimensions of society: political, economic, cultural, and spatial. Course integrates theoretical and philosophical literature on IT with applied policy and planning issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5574 (PSCI 5574):

Arts, Culture and Society

Considers the role of the arts in society, including architecture, music companies, or theater productions to heritage sites, science museums, and art galleries. Effective arts policy in revitalizing urban economies also examined. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5584 (PSCI 5584) (GIA 5584):

Environmental Politics and Policy

Course provides a broad introduction to the key ideas, actors and institutions related to environmental politics and policy in the United States, with some coverage of global issues. It is intended to provide students with basic interdisciplinary knowledge and an intellectual framework for understanding and thinking critically about environmental politics and policy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5604:

Housing Planning and Policy Topics

An examination of national and local housing markets with emphasis on the impact of various public housing policies on the demand for and supply of housing within these markets. The relationships between public and private delivery systems. May be repeated with different topics for a maximum of 9 credit hours. Graduate standing required.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): UAP 5234

Corequisite(s):

UAP 5614:

Topics in City Design Policy

Topics course on the history and theory of city design and the policies that govern design. Design and policy terminology. Identification and selection of policy tools and techniques in various contexts, and to address specific problems of city design. Advantages and disadvantages of city design policy tools. Issues of implementation and administration related to city design policy. May be repeated 2 times with different content for a maximum of 9 credits. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5624 (ARCH 5624):

Urban Design Seminar

Current topics in urban design. Topics may include: theoretical, conceptual and practical concerns in the generation of urban spatial form; the roles of public and private interests in shaping urban form; the effects of urban intensification on the quality of public spaces; environmental issues in urban design; the role of public policy and regulatory mechanisms; the genesis and development of urban typologies. Each seminar will address one of these or related subject areas. Course may be repeated with a different subject for a maximum of 12 credits.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5634:

Urban Design Studio

Urban design studio projects involving the translation of design and planning theory and methodology to actual form-giving proposals for the urban context. Emphasis will be on the development of urban tectonic form in response to functional and behavioral planning, symbolic and aesthetic factors. May be repeated for a maximum of 12 credit hours.

Credit Hour(s): 0 TO 12

Lecture Hour(s): 0 TO 12

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ARCH 4715

Corequisite(s):

UAP 5644:

Transportation Systems Planning

Advanced consideration of problems dealing with transportation systems as they affect the socio-economic development of cities, regions, and

nations; the travel behavior of a populace; the location of economic activity; the use of land; and the allocation of resources.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5674:

Financial Health of Public and Nonprofit Organizations

Concepts and analytical capacities necessary to evaluate the overall level of financial health of governmental and nonprofit/nongovernmental organizations. Examines the tools and techniques necessary to assess the financial condition of the organizations and to determine if they have the capacity to carry out their purposes and address their debt obligations. Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5764:

International Development Studio

International development project initiation and institutional framework; project design processes, criteria, and methods; implementation and evaluation design processes, criteria, and methods. Examination of case projects by public and private donor agencies as a basis for project design.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): UAP 4764
Corequisite(s):

UAP 5764G:

Advanced International Development Planning and Policy

Examination of major development theories and contemporary issues and characteristics of low-income societies (industrialization, urbanization, migration, rural poverty, hunger, foreign trade, and debt) that establish contexts for development planning and policy-making. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5774:

Econ Develp Studio

Principles, concepts, and techniques related to economic development at either the local and regional scale are brought to bear in solving a development problem. Emphasis is on problems which are encountered in planning or implementing economic development.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): UAP 5234 OR UAP 5104
Corequisite(s):

UAP 5784:

Economic Development Planning Topics

An introduction to local economic development programs. Covers intergovernmental relations, financing techniques, federal and local subsidies, advertising, marketing, public relations, labor market issues, tax considerations, fiscal impact analysis, and land use planning issues. May be repeated with different topics for a maximum of 9 credits. Graduate standing required.
Credit Hour(s): 1 TO 3
Lecture Hour(s): 1 TO 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5794:

Environ Plan Studio

Application of environmental planning techniques involving either land use or residuals management in a specific project.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

UAP 5804:

Practicum Problem

The practicum is one option (together with the major paper and thesis) which MUA and MURP Degree candidates may elect to complete their degree requirements. It is intended to provide the candidate with an opportunity to demonstrate: (1) a required degree of comprehension of the concepts, principles and techniques relevant to these fields, and (2) the ability to apply this understanding in a professional manner in a situation which simulates professional practice.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): UAP 5124 OR UAP 5144

Corequisite(s):

UAP 5864:

Topics in Transportation Policy and Planning

Overview of major policy and planning issues in transportation; interdependence of transportation with land-use patterns. Analysis of problems of transportation systems, and alternative solutions examined in the context of the changing political/institutional environment. May be repeated with a different topic for a maximum of 9 credits. Pre-requisite: Graduate Standing required.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

UAP 5914:

Peace Corps Service

Critical evaluation and field-based study of selected complex issues related to society in international context; study of cultural and language diversity; approaches to ethnoinclusiveness in urban and suburban environments; focus on practical local and regional planning for the benefit of local communities in consort with non-profit organizations, governments and global networks. Prerequisite: Graduate Standing and enrollment in the Masters International Program and Peace Corps.

Credit Hour(s): 6

Lecture Hour(s): 6

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5924:

Peace Corp Enrollment

Credit Hour(s): 0

Lecture Hour(s): 0

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

UAP 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

UAP 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

WATER INTERFACE: INTERDISCIPLINARY RESEARCH TRANSCENDING BOUNDARIES OF ENGINEERING, SCIENCE, AND HUMAN HEALTH

Professors: Brenda Davy; Kevin Davy; Andrea Dietrich; Joseph Falkinham; Daniel Gallagher; Sean O'Keefe; Amy Pruden-Bagchi; Stephen Schoenholtz; Elena Serrano;

Associate Professors: Curtis Friedel;

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HNFE: Brenda Davy; Kevin Davy; Valisa Hedrick; Elena Serrano;

CEE: Andrea Dietrich; Daniel Gallagher; Amy Pruden-Bagchi;

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Graduate Site: http://blogs.lt.vt.edu/water/

Graduate Site: http://interdisciplinary.graduateschool.vt.edu/water

Water INTERface: INTERdisciplinary Research Transcending Boundaries of Engineering Science, and Human Health WHAT? WATER is EVERYWHERE, essential for LIFE, but not always supplied in the appropriate QUALITY and QUANTITY. WHO? Collaborative interdisciplinary teams of scientists (physical, biological, health, and social) and engineers that evaluate and implement cost-effective sustainable solutions to global water challenges with integration of technology, health, safety, and public perception issues. WHY? Shortages of fresh water for drinking and agriculture are projected to occur around the world as illustrated by this quote: "….global water consumption is doubling every 20 years, and the United Nations expects demand to outstrip supply by more than 30% come 2040" (Newsweek, October 2010). Demand for usable water necessitates taking poor quality water -waste water (industrial, agricultural, municipal) or sea water- and processing it to meet higher and/or drinking water standards. Technical solutions exist to process water of low quality water into higher quality freshwater. Yet, changes in chemical, nutrient, microbial, and sensory characteristics will influence water use, safety, consumption, health benefits, and risks. In addition, public perception and acceptance of feasible engineering solutions for solving water shortages play important roles in societal adoption of technologies. Collaborative interdisciplinary teams of scientists (physical, biological, health, and social) and engineers that evaluate and implement cost-effective sustainable solutions to global water challenges with integration of technology, health, safety, and public perception issues. WHEN? NOW. WHERE? Virginia Tech Graduate School and the Departments of Human Nutrition, Food and Exercise Food Science and Technology Civil and Environmental Engineering Biology   Opportunities for Interdisciplinary Water INTERface IGEP Students include: Involvement with Water INTERface IGEP community and activities. Participation in blogging and research presentations. Possibility of partial GRA and travel funding. Earn a 9 credit Graduate Certificate in Interdisciplinary Water and Health Science: Advanced Interdisciplinary Issues and Ethics in Water Resources (GEOG 5134), Research Ethics in Agriculture and Life Sciences (ALS 5324), or Engineering Ethics and the Public (CEE 5804) (3 credits) Water for Health Seminar (GRAD 5414) (1 credit) Interdisciplinary Research (GRAD 5134) (3 credits) Independent Research Study (GRAD 5974) (2-3 credits)

SPECIAL FACILITIES

---- Water INTERface IGEP faculty and students have access to state of the art facilities are available for food processing, sensory testing, nutritional analyses, health screening, and chemical/microbial water quality analyses.

Water INTERface IGEP facilities

State of the art facilities are available for food processing, sensory testing, nutritional analyses, health screening, and chemical/microbial water quality analyses. Facilities, Equipment, and Other Resources in Civil and Environmental Engineering The Environmental and Water Resources Engineering Program at Virginia Tech maintains 20,000 ft2 of laboratory space in its Durham Hall and Hancock Hall Facilities. Two full time analytical chemists are on staff to train and assist researchers. Analytical instrumentation in the Durham laboratories that are primarily used for both water and air quality analyses includes: - six Hewlett Packard gas chromatographs with a range of detection systems (including FID, ECD, N/P, and H2) and other assemblies (autosamplers, purge and trap) - Agilent Technologies GC 6890-MSD (GC-MS) - Scientific Instrument Services Short Path Thermal Desorption Model TD-4 - three Dionex ion chromatographs; a Hewlett Packard HPLC with diode array detection; - Beckman UV/visible spectrophotometer with sipper cell - Thermo Electron X-Series inductively coupled plasma with mass spectrometer (ICP-MS) - Schimadzu LC with Diode Array, Refractive Index and Mass Spectrometer Detectors - Two field portable Hanna multi-probes, Model HI9828, for water quality analyses - three constant temperature rooms (5 to 50 oC) - table top equipment: muffle furnaces; ultrasonicators; shaker and mixing equlipment; rotary evaporators; microbalance; analytical balances - gas analyzers for carbon dioxide, carbon monoxide, nitrogen oxides, and ozone. For Water Quality Analysis, there are two (1000 ft2 and 625 ft2) laboratories for setting up experiments. Routine equipment includes pH meters, conductance meters, table-top spectrophotometers (SPEC 20), balances, microscopes, extractors, glassware, autoclaves, hoods, ovens, stirrers, heaters, incubators, flowmeters, hygrometers, ISCO automatic samplers, swing psychrometers, thermohumidigraphs, personal sampling pumps. The laboratory space provides bench tops, hoods, sinks, temperature controlled rooms, walk-in refrigerators, centrifuges, and storage space necessary to perform experimental research. For Air Quality Analysis, there is 400 ft2 of laboratory and computing space in Durham Hall and a shared 2500 ft2 laboratory dedicated to studies of Nanoscience and Technology of the Environment in the Institute for Critical Technology and Applied Science building. Table 1 lists the laboratory's equipment for the analysis of gases and particles, and the laboratory also has numerous filter holders, diffusion denuders, primary flow calibrators, mass flow controllers, and vacuum pumps. Facilities, Equipment, and Other Resources in Food Science & Technology The Food Science and Technology program is housed in two buildings: Food Science and Technology Building (FST) and the Human and Agricultural Biosciences Building 1 (HABB1), which opened in 2014. Additional research labs are located in the Integrated Life Sciences Building (ILSB) in the Virginia Tech Corporate Research Center (CRC), the Virginia Seafood Agricultural Research and Extension Center in Hampton and the Eastern Shore Agricultural Research and Extension Center in Painter. The 93,500 square foot LEED-certified HABB1 building is designed to incorporate open workspaces and communal areas for faculty, students and industry to work collaboratively. Research areas include pilot plants, laboratories, support facilities and a sensory/flavor testing suite with camera-equipped individual sensory panel booths and conference rooms. The pilot plants feature flexible high-bay equipment areas for use in the development of scale-up operations and process/packaging engineering systems. Food Science Building (FST) Administration and faculty, staff, and grad student offices Classrooms and teaching laboratories Packaging and processing pilot plant Research laboratories Product Development and sensory evaluation laboratory Research winery and enology laboratory Analytical Services Lab High hydrostatic pressure processing laboratory Human and Agricultural Biosciences Building 1 (HABB1) Faculty, staff, and graduate offices Conference, team meeting, and seminar rooms Research laboratories Sensory evaluation suite Food processing and packaging pilot plant Food safety pilot plant (BSL2) Facilities, Equipment, and Other Resources in Human Nutrition, Foods and Exercise HNFE occupies space in Wallace Hall, War Memorial Hall, the Integrated Life Science Building at the Corporate Research Center, and VT Riverside in Roanoke. The Laboratory for Eating Behaviors and Weight Management, the Dietary Assessment Laboratory, the Metabolic Kitchen, and the Food and Nutrition Policy Laboratory reside in Wallace Hall. The Integrated Life Sciences Building houses researchers from diverse backgrounds including, but not limited to, virology, biology, nutritional biochemistry, genetics, foods science, and behavioral science. The Molecular Nutrition, Muscle Function, and Muscle Metabolism laboratories can be found here as well as groups working on the molecular aspects of health, nutrition, and disease, including genetic determinants of obesity and the prevention of cancer, diabetes, and hypertension. This research is performed in laboratories equipped with modern molecular and cell biology instruments and tools for cellular and animal research. The building also houses equipment for the metabolic phenotyping core that allows for determination of body composition, whole body energy metabolism, glucose and insulin tolerance, analysis of metabolites, and more. Furthermore, core facilities for quantitative real-time PCR, cell culture, radio-labeled substrate metabolism, mitochondrial function, histology, confocal microscopy, and flow cytometry are also located in the building. The Human Integrative Physiology laboratory is located in War Memorial Hall and provides the infrastructure for clinical studies requiring measurements of cardiovascular structure and function, submaximal and maximal exercise performance, body composition (DEXA), resting and exercise energy expenditure and substrate metabolism, and collection and processing of tissue and blood samples. University Facilities Available - Resources are available through fee facilities for machine, electrical, and glass blowing. - ICTAS Nanoscale Characterization and Fabrication Laboratory for surface characterization which provides access to advanced equipment for electron microscopy, optical microscopy, and several spectroscopic techniques training for students and researchers in the use of the lab's instrumentation . This is a fee facility. - Learning Technologies Digital Media Center and Innovation Space which is a multimedia computer lab open to the students, faculty, and staff of Virginia Tech, as well as the local general public, with the mission of providing assistance through free and open access to software, hardware, and specially-trained staff. Includes access to still and video equipment, sound recording and processing, image and sound digital manipulation. - Video Conferencing Facilities- 15 video conferencing sites available on & off campus. - Conference room, office space/office equipment/computer facilities. - Student office space in former dormitory; available for office or research.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

Each Water INTERface graduate student must meet the requirements of their home academic department in addition to the overall Water INTERface requirements. It is also expected that students will be participate in Water INTERface IGEP community events/activities, write blogs, and conduct research presentations. A nine credit Graduate Certificate in Interdisciplinary Water and Health Science requires the following four courses: Ethics course (complete one of the following): Advanced Interdisciplinary Issues and Ethics in Water Resources (GEOG 5134) (3 credits) Research Ethics in Agriculture and Life Sciences (ALS 5324) (3 credits) Engineering Ethics and the Public (CEE 5804) (3 credits) Interdisciplinary Research (GRAD 5134) (3 credits) Water for Health Seminar (GRAD 5414) (1 credit) Independent Research Study (GRAD 5974) (2 credits)

Africana Studies
AFSC

Address:
514 Major Williams Hall (0130) Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Brandy Faulkner

Web Resource(s):
• Website
• Website for Undergraduate Minor

Phone Number(s):
• *Office:*
540/231-5509

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Africana Studies

A graduate certificate in Africana Studies serves two populations: graduate students in other programs at Virginia Tech who would like to demonstrate additional competence in some aspect of Africana Studies, and non-degree seeking students who desire special competence in Africana Studies for personal development/career advancement. Graduate students in Higher Education and Student Affairs (HESA) and the Center for Public Administration and Policy (CPAP) can use this certificate as a cognate within their degree programs.

How to Apply:
Fill out the online application for participation in the certificate program.

Africana Studies
AFSC

Address:
514 Major Williams Hall (0130) Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Brandy Faulkner

Web Resource(s):
• Website
• Website for Undergraduate Minor

Phone Number(s):
• *Office:* 540/231-5509

Admission Requirements

Graduate students accepted in any graduate program at Virginia Tech may be admitted to the Africana Studies certificate program. Decisions for admission to the certificate program for non-degree seeking students are made by the Sociology Graduate Admissions Committee, based on transcripts, a writing sample, and a statement of purpose.

Course Requirements

Students are required to take and pass four of the five Africana Studies graduate courses with a B average. (12 hours).

The current courses are as follows:

- AFST 5224 Africana Studies Professional Seminar
- AFST 5234 Research Methods in Africana Studies
- AFST 5314 Theories in Africana Studies
- AFST 5354 Topics in Africana Studies
- AFST 5434 History of Africana People

Contact Brandy Faulkner (bfaulkne@vt.edu) for more information about Africana Studies and opportunities for graduate student engagement.

Applied Economic Analytics
AEAC

Address:
309B Hutcheson Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Normand Adams

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Applied Economic Analytics Overview

- - - - -

How to Apply:
Fill out the online application for participation in the certificate program.

Applied Economic Analytics
AEAC

Address:
309B Hutcheson Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Normand Adams

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Applied Economic Analytics Admission Requirements

- - - - -

Applied Economic Analytics Course Requirements

- - - - -

Applied Statistics
ASTC

Address:
406A Hutcheson Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Christina Dillon
• Cherie Nelson

Web Resource(s):
• Applied Statistics Graduate Certificate

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Applied Statistics Graduate Certificate

The Graduate Certificate in Applied Statistics is designed to teach students the fundamental principles of statistics and the skills necessary to use statistical computer programs for data analysis. Students will learn how to choose the appropriate statistical model for a research project, prepare a data set for analysis, and use the applicable computer software program to analyze data sets. The program covers topics such as statistical inference, modeling, and computer programs (e.g. R Suite, SAS). Graduates will be prepared to use statistical methods and software programs to analyze data sets and summarize the results.

The certificate has two target audiences: 1) graduate students currently enrolled in a graduate degree program related to applied statistics (e.g., Statistics, Higher Education, Educational Leadership and Policy Studies) and 2) current data analysis professionals in organizations that gather and analyze data, such as marketing companies and nonprofit agencies.

Full-time and part-time students may enroll in the certificate program, Degree-seeking students may take courses in conjunction with their regular course load. Students attending full-time can complete the certificate in a minimum of one academic year (two semesters) and a maximum of three academic years (six semesters). Degree-seeking students attending part-time can complete the certificate in approximately two academic years (four semesters) and a maximum of four academic years (eight semesters).

Non-degree seeking, full-time students can complete the certificate in a minimum of one academic year (two semesters). Non-degree seeking, part-time students, taking one course per semester, can complete the certificate in two academic years (four semesters).

How to Apply:
Fill out the online application for participation in the certificate program.

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Applied Statistics
ASTC

Address:
406A Hutcheson Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Christina Dillon
• Cherie Nelson

Web Resource(s):
• Applied Statistics Graduate Certificate

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission

All students will be required to apply to the certificate program. The admission requirements will be based on enrollment status at the institution.

Degree-seeking students:

- Submit a Graduate Certificate Application
- Possess a bachelor’s degree from an accredited institution with a GPA of 3.0 or better

Non-degree seeking students:

- Submit a Graduate School Application for admission and pay the fee
- Submit a Graduate Certificate Application and pay the fee
- Possess a bachelor’s degree from an accredited institution with a GPA of 3.0 or better
- Submit official undergraduate transcripts demonstrating bachelor’s degree conferral
- Undergraduate coursework and statistics in computer programming are recommended.
- Students who have not earned a degree in the United States must submit Test of English as a Foreign Language (TOEFL) minimum score of 90 on the internet-based (iBT) or the International English Language Testing System (IELTS) with a minimum score of 6.5
- TOEFL scores of 20 or greater in Listening, Writing, Speaking, and Reading subsections

Curriculum Requirements

The curriculum requires coursework to develop students’ knowledge of statistical modeling (e.g., multiple linear regression, analysis of variance) and modern statistical programs (e.g., R Suite, SAS, JMP, SPSS). Students will learn about analyzing, summarizing, and interpreting the results of data analyses. Students will gain an understanding of how to prepare raw data sets for analysis and how to choose the most appropriate statistical model for a given research goal/project (e.g., hypothesis testing, interval estimation). Students will learn how to use statistical software programs to analyze a data set.

The certificate requires completion of twelve credit hours consisting of three required core courses and a fourth course selected from a choice of two restricted electives. All courses for the certificate must be graded. Students must attain a minimum GPA of 3.0 in all four courses.

Program Requirements

Total Number of Credit Hours: 12 graduate credits (Transfer credits are not permitted.)
Required Core Courses – 9 credits

- STAT 5615 – Statistics in Research I. (3H, 3C)
- STAT 5616 – Statistics in Research II. (3H, 3C)
- STAT 5054 – Introduction to Statistical Computing. (3H, 3C).

Restricted Electives – 3 credits (select one)

- STAT 5024 – Communication in Statistical Collaborations. (3H, 3C)
- STAT 5904 – Project and Report. (3H, 3C)

Course Delivery Format

The certificate program will be conducted in a hybrid format. Some courses are classroom-based, located on the Virginia Tech campuses in Blacksburg and the National Capital Region. Some courses are delivered via distance learning from Virginia Tech Blacksburg to Virginia Tech National Capital Region or vice versa. Some courses are delivered online.

Graduate School, Virginia Tech. Copyright 2023

Arts Leadership
ALC

Address:
344 Henderson Hall (0141) 195 Alumni Mall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Amanda Nelson

Web Resource(s):
• Program details

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Arts Leadership

The graduate certificate in Arts Leadership is designed to prepare professionals to pursue work in arts management. Students will develop specific knowledge of a variety of arts management areas, such as arts leadership and management, nonprofit financial management, arts marketing, development (fundraising), and arts advocacy.

The Arts Leadership Certificate is intended for graduate students, currently enrolled in a graduate degree program at Virginia Tech, and local professional interested in learning skills and gaining knowledge in arts management.

How to apply: Contact Dr. Amanda Nelson via email amandajnelson@vt.edu. The online application to participate in the certificate program may be found here.

How to Apply:
Fill out the online application for participation in the certificate program.

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Arts Leadership
ALC

Address:
344 Henderson Hall (0141) 195 Alumni Mall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Amanda Nelson

Web Resource(s):
• Program details

Phone Number(s):

Graduate Certificate in Arts Leadership

Degree-seeking applicants

For admission to a graduate degree program, the Graduate School requires:

- Completion of a bachelor’s degree from an accredited institution
- GPA of 3.0 or better for the last half of the credits earned for the undergraduate degree
- Submission of official transcripts
- International applicants must submit scores from the Test of English as a Foreign Language (TOEFL) with a minimum of 550 paper-based (PBT) or 90 internet-based test (iBT), or the International English Language Testing System (IELTS) with a minimum score of 6.5

To earn a graduate certificate along with a degree:

- Students must submit a Graduate Certificate Application
- Students are classified within their degree program
- Up to 50% of the certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study.

Non-degree seeking applicants

Persons who wish to enter Virginia Tech to obtain a graduate certificate without being enrolled in a degree program may apply for admission to Graduate Certificate status as follows:

- Submit an Application for Admission and a Graduate Certificate Application
- Completion of a bachelor’s degree from an accredited institution
- GPA of 3.0 for the last half of the credits earned for the undergraduate degree
- Submit official transcripts
- Possess an academic background appropriate for the Certificate
- International applicants must submit scores from the Test of English as a Foreign Language (TOEFL)

with a minimum of 550 paper-based (PBT) or 90 internet-based test (iBT), or the International English Language Testing System (IELTS) with a minimum score of 6.5

Graduate Certificate in Arts Leadership Courses

Students will need to successfully complete 12 credit hours/4 courses to earn the Certificate in Arts Leadership. Students will be required to take one of the topics offered through the core course TA 5614: Topics in Arts Leadership I. Topics rotate and include arts management, arts leadership, or arts advocacy. Please refer to the timetable of classes for specific offerings each semester.

Students will also **select three electives** from those listed below which cover a range of specialized topics in arts management, including financial management for the arts, arts marketing, development (fundraising), and human resources in the arts.

Topics courses are not sequential, and students may take elective courses prior to fulfilling the core course requirement.

Course Options

TA 5614 Topics in Arts Leadership I (3credits; may be repeated for credit with different content)
Topic-centered investigation in arts management, leadership, or advocacy.

TA 5624 Topics in Arts Leadership II (3 credits; may be repeated for credit with different content)
Topic-centered investigation in specialized areas of arts management: arts marketing, development (fundraising), or grant writing.

TA 5634 Topics in Arts Leadership III (3 credits; may be repeated for credit with different content)
Topic-centered investigation in various areas of advanced arts management: human resources, financial management, or strategic management.

UAP 5574 Arts, Culture, and Society (3 credits)
Considers the role of the arts in society, including architecture, music companies, or theatre productions to heritage sites, science museums, and art galleries.

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Big Data
BDC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Big Data

The purpose of this certificate is to provide students with a solid foundation in modern tools and technologies to succeed as a machine learning applications and deployment engineer. The emphasis is on foundational methods spanning data storage and querying, data analysis, and data visualization. Specific emphasis is also placed on social media data, one of the fastest growing segments of the big data economy. The certificate prepares students in state-of-the-art languages and pipelines for machine-learning algorithm implementation over massive datasets.

Learning Outcomes: Students who complete this certificate will be able to

- Explain how Big Data applications are built using architectures, such as Apache Hadoop, Apache Spark, NoSQL, and MongoDB.
- Use object-oriented programming to implement data processing pipelines using Python and Big Data architectures.
- Tackle practical programming issues underlying storing, retrieving, accessing, and processing large datasets.
- Implement machine learning methods and apply them to large scale datasets.
- Implement specialized pipelines for analyzing social media data, including network analysis, information extraction, and sentiment analysis.
- Apply fundamentals of data and information visualization to deliver visual insights.
- Analyze real-world datasets to develop applications.

Target Audience and Time to Complete:

The target audience is Virginia Tech graduate students who are interested in adding expertise in data management and analysis to that gained in their current degree program. However, we also expect that a number of other professionals will pursue the certification both for job knowledge and career enhancement. Those students will be admitted as non-degree seeking, MIT-Commonwealth students.

How to Apply:
Fill out the online application for participation in the certificate program.

Graduate School, Virginia Tech. Copyright 2023

Big Data
BDC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Admission Requirements for the Graduate Certificate in Big Data

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
  - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
  - Earn a minimum IELTS score of 6.5.
  - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Big Data

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

CS 5044 Object-Oriented Programming with Java: Object-oriented programming concepts and the Java programming language. The application of design strategies, notations, and patterns related to object-oriented systems. Techniques and libraries for developing applications related to the World Wide Web.

CS 5644 Machine Learning with Big Data: Basic principles and techniques for big data analytics, including methods for storing, searching, retrieving, and processing large datasets; introduction to basic machine learning libraries for analyzing large datasets; data visualization; case studies, with real-world datasets. Pre: CS 5044.

CS 5664 Social Media Analytics: Social media platforms, media feeds, and data formats; machine learning and graph theory foundations of social media analytics; Forms of social media analytics – text analytics, network analytics, and action analytics; Forecasting models and applications, including in marketing, event tracking, surveying, and A/B testing. Pre: CS 5044.

Biobased Materials
BBMC

Address:
230 Cheatham Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Maren Roman

Web Resource(s):
• Website

Phone Number(s):
• *Phone::*
540/231-1421

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This certificate is offered by the Bio-based Materials Center. Information on how to apply for the certificate can be found here.

How to Apply:
Fill out the online application for participation in the certificate program.

Biobased Materials
BBMC

Address:
230 Cheatham Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Maren Roman

Web Resource(s):
• Website

Phone Number(s):
• *Phone::*
540/231-1421

Admission Requirements

Admission into the program for the Certificate in Biobased Materials requires:

- a bachelor's degree in a scientific or engineering discipline
- enrollment at the graduate level at Virginia Tech as
  - a degree seeking student,
  - a non-degree seeking student, or
  - a Commonwealth Campus student
- good academic standing (for currently enrolled Virginia Tech students)
- submission of a completed application form

Please note that the graduate school will not grant the certificate unless at least one of the courses has been taken in or after the 2011 Spring Semester (i.e., after approval of the certificate program).

Course Requirements

The certificate requires completion of a minimum of nine credit hours from the following list of courses. Students must attain a minimum GPA of 3.0 in the courses counting towards the Certificate. Related Virginia Tech courses not included in the list may be substituted. Course substitution requests must be approved by the certificate faculty in the Department of Wood Science and Forest Products.

BCHM 5124 – Biochemistry for the Life Sciences
Basic principles of biochemistry including protein structure, enzymology, gene expression, bioenergetics, and pathways of energy metabolism. Not available to Biochemistry majors. I. (3H, 3C)

BCHM 5224 – Protein Structure and Function
Structure and function of proteins. Topics include special techniques in protein purification and characterization, techniques for studying protein structure, posttranslational modification of proteins and selected topics to study the structure-function relationship of proteins. Taught alternate years. I. (3H, 3C)

BCHM 5304 – Enzyme Kinetics and Reaction Mechanisms
Analysis of the mechanisms of enzyme-catalyzed reactions using kinetic and spectroscopic measurements, inhibitors and other chemical probes, or enzyme modification via sitedirected mutagenesis. Development and interpretation of kinetic rate equations. Theory and models of enzymatic catalysis. II. Alternate years. (3H, 3C)

BSE 5504G – Advanced Bioprocess Engineering
Study of the engineering concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals. Emphasis is placed on enzyme kinetics and technology, bioreaction kinetics, analysis, and control of bioreactors and fermenters, and downstream processing of bioreaction products. II. (3H, 3C)

BSE 5544G (CHE 5544G) – Advanced Protein Separation Engineering

Concepts, principles and applications of various unit operations used in protein separations. Properties of biological materials, such as cells and proteins, and their influences on process design. Design of processes for protein purification based on the impurities to be eliminated. Concepts and principles of scale-up of unit operations. Case studies in practical protein recovery and purification issues, with a focus on enhanced protein purification by genetic engineering. Protein purification process simulation and optimization using process simulation software. (3H, 3C)

BSE 5644 – Biobased Industrial Polymers
Importance of renewable feedstocks (i.e., proteins, polysaccharides, and fats) to industrial polymers and the future economy. Chemistry and processing of plant- and animal-based feedstocks into polymers. Properties of renewable materials. (3H, 3C)

BSE 5624 – Enzyme Engineering
Introduction to enzymatic biocatalysis. Enzyme kinetics on solid and soluble substrates. Directed enzyme evolution vs. rational enzyme design. Cell-free synthetic enzymatic pathway engineering. (3H, 3C)

CHE 5214 (BMES 5434) – Polymeric Biomaterials
This is an interdisciplinary course intended for graduate students. The major objective of this course is to introduce principles and concepts critical to the successful design of polymerbased biomaterials, drug-delivery devices, and bio-implants. The course will be broken down into the following four areas, polymer design and processing, inflammatory responses to polymers, interaction of blood with polymeric materials, and the effect of mechanical, chemical, and surface properties of polymers on cells. Students will be expected to know undergraduate engineering, polymers, and, biology. (3H, 3C)

WOOD 5424 (CHEM 5424) – Polysaccharide Chemistry
Structure, properties, and applications of natural polysaccharides. Natural sources and methods of isolation. Synthetic chemistry and important polysaccharide derivatives. Relation of structure and properties to performance in critical applications including pharmaceuticals, coatings, plastics, rheology control, and films. Conversion by chemical and biochemical methods of polysaccharide biomass to fuels and materials. Graduate standing required. (3H, 3C)

MACR 5015 or* 5016 – Macromolecular Fundamentals Laboratory I and II
The course will cover fundamentals and experimental techniques for the synthesis and characterization of polymeric materials. MACR 5015 includes statistical experimental design, step-growth and chain-growth polymerization, natural polymers, molecular modeling, thermal properties of polymers, molecular weight analysis, morphology, and melt and solution rheology. MACR 5016 includes static and dynamic mechanical analysis, rubber elasticity, spectroscopy, surface analysis, fracture behavior, and basic polymer processing. Must meet pre-requisites or equivalent. (2H, 1L, 3C)

*only one of the two courses, either MACR 5015 or MACR 5016, may be applied toward the certificate

Graduate School, Virginia Tech. Copyright 2023

Business Data Analytics
BDAC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Graduate Certificate in Business Data Analytics

Jobs for business intelligence analysts — employees tasked with studying and analyzing large amounts of data generated by businesses — are opening up faster than they can be filled. Corporate executives are overwhelmed with volumes of data needing analysis and summary for better decision making. Forbes listed the business intelligence analyst among its top 10 best-paying science, technology, engineering and mathematics (STEM) jobs last year. While some industries have a greater need for this role than others, the position is by no means industry-specific — it can be found in a wide variety of settings. In the business intelligence and analytics module students (1) learn core intranets: electronic data interchange, electronic banking and payment systems, security and firewalls, software agents, and the social, legal, and international issues of electronic commerce; (2) review business intelligence and analytics technologies; (3) define and frame the business context for decisions, decision models, data issues, business intelligence, building analytics capability, cloud computing, making organizations smarter, and measuring the value of analytics; and (4) study analytics software and techniques: data preparation, data exploration and visualization, predictive analytics techniques, text analytics, and spatial analytics.

In today's business environment, ad-hoc approaches to information systems development are not sufficient. Modern approaches to the development of information systems, such as structured systems development, relational database development, and object-oriented systems development, are required. The Business Information Systems module prepares the student to become a business information systems developer using both structured and object-oriented systems development approaches. It also prepares the student to be able to design and develop business information systems that use a relational database. In this module, the student studies the strategies and techniques for dealing with the inherent complexity in the development of information systems. System development topics include coverage of (1) business systems planning; (2) fact-finding and requirements analysis techniques; (3) information systems process modeling; (4) logical and physical design; (4) user interface design; (5) introduction to database management systems and their use in business. Database topics covered include (1) data modeling, (2) normalization, (3) SQL, (4) transaction management and concurrency control, (5) physical data organization, (6) query optimization, (7) database administration, (8) distributed databases, (9) data warehousing, (10) integrating databases with the web.

One of the core problems in the broad arena of Information Technology is the extraction of useful information from massive amounts of data that is collected and stored. Two closely related disciplines lie at the head of the problem. The first is the construction of efficient, logically organized databases that reflect the physical and organizational realities that comprise the problem domain; and the second is the extraction of useful business intelligence from those databases.

This set of three courses in the certification in Business Data Analytics will provide students with the specialized knowledge required to attack this problem domain.

How to Apply:
Fill out the online application for participation in the certificate program.

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Business Data Analytics
BDAC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Admissions Requirements for the Graduate Certificate in Business Data Analytics

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
    - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
    - Earn a minimum IELTS score of 6.5.
    - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Business Data Analytics

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

BIT 5524 Introduction to Business Intelligence & Analytics: Overview of business intelligence and analytics technologies and their strategic use including defining/framing the business context for decisions, decision models, data issues, business intelligence, building analytics capability, cloud computing, making organizations smarter, and measuring the value of analytics.

BIT 5534 Applied Business Intelligence and Analytics: Development of business intelligence and analytics solutions and applications to various types of decision-making problems. Analytics software preparation, data exploration and visualization, predictive analytics techniques, and text analytics, spatial analytics. Pre: BIT 5524.

ACIS 5524 Advanced Database Management Systems: Relates database theories and practices to concepts from other areas such as programming languages, algorithms, data structures, and information systems. The relational, network, and hierarchical models are introduced. A major portion of the course deals with data manipulation languages for the relational model, design theory for relational databases, and query optimization. Pre: ACIS 5504.

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Cognition and Education
CEC

Address:
School of Education (0313)
Blacksburg, Virginia 24061

Contact this Certificate

Email Contact(s):
• Dr. Brett Jones

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Graduate Certificate in Cognition and Education provides an advanced understanding of current theories and principles of academic learning and motivation, as well as strategies that instructors can use to foster students' learning and motivation. Students who complete the certificate will have documentation that they have developed the intellectual and practical tools necessary to design effective instruction.

The *Certificate in Cognition and Education* is appropriate for graduate students who are considering careers as teachers, higher education professors, educational researchers, educational program administrators, educational leaders, instructional designers, sports coaches, and others interested in designing effective instruction.

How to Apply:
Fill out the online application for participation in the certificate program.

Cognition and Education
CEC

Address:
School of Education (0313)
Blacksburg, Virginia 24061

Contact this Certificate

Email Contact(s):
• Dr. Brett Jones

Web Resource(s):
• Website

Phone Number(s):

Admission Requirements

To be eligible for the certificate, students must have completed an undergraduate degree.

Course Requirements

Students must complete 3 of these 4 courses (for a total of 9 credit hours of coursework) with a grade of B or better:

- EDEP 5114 Learning and Cognition,
- EDEP 6114 Cognitive Processes and Educational Practice,
- EDEP 6224 Constructivism and Cognition, or
- EDEP 6444 Motivation and Cognition.

Students may complete the three courses in any order; however, it is recommended that students complete EDEP 5114 before enrolling in EDEP 6114 because some of the foundational learning concepts are provided in EDEP 5114.

NO SUBSTITUTIONS for these courses are allowed because this certificate has already been approved and these are the courses that are acceptable for this certificate.

Application Process

Applications are reviewed as they are received during the fall and spring semesters; there are no deadlines for applications.

1. To apply for the certificate, students need to complete the Application to Graduate Certificate Program (in the *Admissions* section of https://graduateschool.vt.edu/forms.html) and email it to Brett Jones (brettjones@vt.edu), who will provide the "Certificate Program Approval Signature." Dr. Jones will then forward the form to the Graduate School for their signature. This form starts the process by designating the courses that will be taken for the certificate.

2. During the semester in which the certificate requirements are completed, students should complete the Degree or Certificate Conferral Request (in the *Graduation* section of https://graduateschool.vt.edu/forms.html) and give it to Kathy Tickle (ktickle@vt.edu).

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Collaborative Community Leadership
CCLC

Address:
214 Litton-Reaves Hall, Mail Code: 0343
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Eric K. Kaufman
• Ginger B. Dempsey

Web Resource(s):
• Website

Phone Number(s):
• *Eric K. Kaufman:*
540/231-6258
• *Ginger B. Dempsey:*
540/231-6337

Certificate Overview | Admissions & Course Requirements

Why this certificate?

According to national surveys, less than a third of Americans believe leaders in the United States are effective, and more than half believe the issue has become worse in the last 20 years (Shollen & Gagnon, 2019). While many express healthy skepticism of the heroic approaches to leadership (Crosby & Bryson, 2017), recent evidences suggests key opportunities in the collective dimensions of leadership (Ospina, Foldy, Fairhurst, & Jackson, 2020). In our rapidly changing world, we need leaders with interdisciplinary skills to solve complex societal issues on local, national, and international levels (Bear & Skorton, 2019). The Collaborative Community Leadership graduate certificate program will prepare participants with the educational background necessary to lead in a diverse and multi-cultural environment.

This certificate will complement Virginia Tech graduate students' academic education by preparing them with the following abilities:

- Apply knowledge of leadership principles in interdisciplinary and transdisciplinary contexts,
- Engage in scholarly inquiry as a way to critically analyze leadership theory and practice,
- Promote collaborative leadership in real-world settings, and
- Practice social responsibility in today's diverse and multicultural environment.

How to Apply:
Fill out the online application for participation in the certificate program.

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Collaborative Community Leadership
CCLC

Address:
214 Litton-Reaves Hall, Mail Code: 0343
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Eric K. Kaufman
• Ginger B. Dempsey

Web Resource(s):
• Website

Phone Number(s):
• *Eric K. Kaufman:* 540/231-6258
• *Ginger B. Dempsey:* 540/231-6337

Certificate Overview | Admissions & Course Requirements

Admission & Conferral

Admission to the graduate certificate program in Collaborative Community Leadership will be considered from students enrolled in any graduate program at Virginia Tech and from non-degree students who have been admitted to take courses by the Graduate School. Students who intend to pursue the certificate should complete the Graduate Certificate Application. When all requirements have been satisfied, participants will submit an application for certificate conferral to have the certificate added to their academic transcript.

Curriculum

The certificate requires successful completion of 13 credit hours, including completion of a project that demonstrates application of concepts from the program. The required coursework includes two core courses and two courses from restricted electives. All courses are graduate-level and three credit hours. The project should be completed with one credit hour of independent study credit (LDRS 5974). The website's list of possible electives is not all-inclusive. Students may propose alternate options to the certificate coordinator. Common course prefixes for alternate options include COMM, GIA, PAPA, UAP, MGT, and PSYC.

Construction Engineering for Infrastructure Projects
CEIC

Address:
200 Patton Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Michael Biscotte
• Sarah Martin

Web Resource(s):
• CEIP Website

Phone Number(s):
• *Sarah Martin:*
540/231-6069

Certificate Overview | Admissions & Course Requirements

Construction Engineering for Infrastructure Projects Overview

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How to Apply:
Fill out the online application for participation in the certificate program.

Construction Engineering for Infrastructure Projects
CEIC

Address:
200 Patton Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Michael Biscotte
• Sarah Martin

Web Resource(s):
• CEIP Website

Phone Number(s):
• *Sarah Martin:*
540/231-6069

Certificate Overview | Admissions & Course Requirements

Construction Engineering for Infrastructure Projects Admission Requirements

- - - - -

Construction Engineering for Infrastructure Projects Course Requirements

- - - - -

Cybersecurity Engineering
CSEC

Address:
1185 Perry Street 453 Whittemore (0111)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Joe Tront
• Paul Plassmann

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Cybersecurity Engineering (CSEC) Graduate Certificate focuses on developing advanced knowledge and skills in key areas of cybersecurity, including information security, network security, software security, and hardware security. The certificate targets both non-degree students interested in deepening their understanding, in addition to graduate students within computer science, computer engineering, and electrical engineering who seek to concentrate their coursework in cybersecurity. The certificate will be available in both Blacksburg and Northern Virginia, but there is expected to be significant growth in the Northern Virginia enrollment as part of university investment in cybersecurity.

The Cybersecurity Engineering (CSEC) Graduate Certificate seeks to help address the major cybersecurity workforce skills gap within the Commonwealth of Virginia and more broadly the Washington DC region. This certificate focuses on Virginia Tech's contribution to this ecosystem in developing deeply technical engineering and computer science skills in security. Virginia has among the densest cybersecurity workforces in the world, but also has among the highest percentage of cyber jobs unfilled. This certificate will help partially address those challenges by packaging together a range of graduate engineering and computer science courses that can be offered both as part of a graduate degree or to non-degree post-baccalaureate students.

How to Apply:
Fill out the online application for participation in the certificate program.

Cybersecurity Engineering
CSEC

Address:
1185 Perry Street 453 Whittemore (0111)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Joe Tront
• Paul Plassmann

Web Resource(s):
• Website

Phone Number(s):

Admission Requirements

Admission to the Graduate School and completing a Graduate Certificate Application are required for all students.

The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better for admission to Certificate Status. Applicants with an undergraduate GPA < 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program. Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study. The faculty administering the Certificate will assist students with determining course selection.

Course Requirements

A student can earn a graduate certificate in Cybersecurity Engineering when he/she completes the following 4 courses:

Required
- CS/ECE 5560 Fundamentals of Information Security

Restricted Electives (pick 2)
- ECE/CS 5580, Cryptographic Engineering
- ECE/CS 5584, Network Security
- ECE/CS 5590, System and Software Security

Electives (pick 1)
- CS 5204, Operating Systems
- ECE/CS 5504, Computer Architecture
- ECE 5520, Secure Hardware Design
- CS/ECE 5565 Network Architecture and Protocols I
- CS 5704 Software Engineering

*A 5000- or 6000-level special topics or advanced topics course may be approved as a substitute given prior approval by the CS/ECE department.

Cybersecurity Management
CSMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Cybersecurity Management

The purpose of this certificate is to provide students with a broad understanding of concepts and principles that will support management of organizations with cybersecurity concerns. The certificate will prepare students to plan, manage, and assess cyber technologies needed to secure critical corporate data and information. The emphasis will be on operational design, technology acquisition, risk assessment, and governance.

Learning Outcomes: Students who complete this certificate will be able to

- Craft corporate and business level understanding of the role of the leader in crafting corporate and business strategies where technology provides the basis for the firm’s competitive advantage
- Develop an entrepreneurial plan for a technology start-up business
- Apply various business tools and strategies in managing a tech-based organization
- Examine risks posed by cyber threats to individuals, organizations, and society
- Critique prevailing national and international strategies for protecting cyberspace

How to Apply:
Fill out the online application for participation in the certificate program.

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Cybersecurity Management
CSMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Admission Requirements for the Graduate Certificate in Cybersecurity Management

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
  - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
  - Earn a minimum IELTS score of 6.5.
  - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Cybersecurity Management

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

MGT 5804 Strategic Leadership in Technology-Based Organizations: This course focuses on the role of the leader in crafting corporate and business strategies where technology provides the basis for the firm's competitive advantage.

BIT 5134 Cybersecurity Program Design and Operations: Broad coverage of the enterprise cybersecurity life-cycle. Design of a comprehensive and resilient enterprise cybersecurity program that aligns with the business objectives. Implementation and management of security operations. Security assessments and remediation of deficiencies. Security intelligence, analytics, and incident response. Measurement and communication of program effectiveness.

ACIS 5624 Cybersecurity Governance and Risk Management: Cybersecurity governance and risk management program in organizations. Governance frameworks for cybersecurity and external drivers for cybersecurity. Risk management, including existing frameworks, principles, and strategies related to risk assessment and implementation of cybersecurity policies, controls and procedures. Budgeting and evaluation of risk management programs. Compliance with organizational cybersecurity programs, including risks of insider threats, management of security-related personnel, and establishment of cyber hygiene. Cybersecurity in relation to cybersecurity regulation.

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Cybersecurity Policy
CSPC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Cybersecurity Policy

This certificate aims to provide students with a broad understanding of key factors influencing policies on cybersecurity at all levels. Cybersecurity policy is inherently trans-disciplinary, incorporating elements of technology, business, criminology, and national/international governance. The emphasis is to equip students with a strong understanding of these elements and prepare them to implement policies that improve the state and practice of cybersecurity for all stakeholders.

One need look no further than recent headlines for a plethora of examples demonstrating the need for government and industry leaders who understand how to develop, interpret, and apply cybersecurity policy. The diverse set of knowledge, skills, and abilities needed to do this successfully cannot come from a predominately technology-focused curriculum. This certificate will prepare students from a variety of backgrounds to be both tech-savvy and societally-aware in implementing policies that affect cyber security, privacy, and safety in the modern age.

Learning Outcomes: Students who complete this certificate will be able to

- Examine risks posed by cyber threats to individuals, organizations, and society.
- Critique prevailing national and international strategies for protecting cyberspace.
- Integrate legal and ethical factors in policy and technical strategies to address cyber and data threats.
- Analyze and implement legal requirements that affect the management of information, data, and defenses across multiple regulatory platforms.
- Address National Security issues from multiple public and private perspectives.
- Create technologies that meet the standards of privacy and security by design

Target Audience and Time to Complete:

The target audience is Virginia Tech graduate students who are interested in adding expertise in cybersecurity policy to that gained in their current degree program. In addition, we also expect that a number of professionals will pursue the certificate both for job knowledge and career enhancement. Those students will be admitted as non-degree seeking certificate students.

In most cases time to completion will be two semesters. Degree-seeking students may take courses in conjunction with their regular course load. Students attending full-time can complete the certificate in a minimum of one academic year and a maximum of four academic years. Degree-seeking students attending part-time can complete the certificate in approximately two academic years and a maximum of three academic years.

Non-degree seeking, full-time students can complete the certificate in a minimum of one academic year (two semesters). Non-degree seeking, part-time students, taking one course per semester, can complete the certificate in two academic years (four semesters).

Master of Information Technology (MIT) Program

MIT Graduate Certificates

How to Apply:
Fill out the online application for participation in the certificate program.

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Cybersecurity Policy
CSPC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:* 703/538-8384

Admissions Requirements for the Graduate Certificate in Cybersecurity Policy

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
    - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
    - Earn a minimum IELTS score of 6.5.
    - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Cybersecurity Policy

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

BIT 5594 Web Applications and Electronic Commerce: An examination of the concepts, technologies, and applications of electronic commerce. Topics include the World Wide Web as a platform for electronic commerce; intranets; electronic data interchange; electronic banking and payment systems; security and firewalls; software agents; and the social, legal, and international issues of electronic commerce.

BIT 5114 Crime and Conflict in Cyberspace: In-depth exploration of the cyber threat landscape and the motives, methods, and mechanisms that shape it. Complex and evolving nature of security, privacy, and safety in cyberspace. Consequences posed by cyber threats at the individual, corporate, and national, and societal levels. Cyber threat research and analysis. National and international strategies for protecting cyberspace.

BIT 5124 Cyber Law and Policy for Information Technology: Key legal, ethical, and policy cyber governance and cyber security topics for managers and information security officers. Legal rights, remedies, and limitations related to cybercrime, computer intrusion, national security, and data breaches. Privacy laws and standards, impact assessments, privacy and security by design as policy and legal requirements.

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Cybersecurity Technologies
CSTC

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703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Cybersecurity Technologies

The cutting edge of IT Security extends well beyond the traditional defensive measures employed by most business and public sector entities today. And at the edge lies the collection and assessment of threat data. However, collection requires an understanding of the probable data elements that constitute a realistic threat; while assessment requires a sophisticated understanding of the systems and technologies used to collect this information.

Knowledge on Internet Security best practices, attack and defense strategies is rapidly becoming a required skill for today's Information Technology worker. There are few opportunities for students to gain hands-on experience in IT risk analysis, auditing methodologies and incident response. This class introduces students to the fundamentals of computer and network security. It is a hands-on course where students learn how to analyze a client/server IT infrastructure for security weaknesses. Students also gain practical experience in analyzing common practices for security vulnerabilities that could result in the loss of sensitive company and customer information. The second course provides advanced network security knowledge to allow students to build trustworthy systems and to protect critical infrastructures through an understanding of how to engineer and evaluate relevant security solutions. The course covers security and trust aspects of wireless mobile and ad hoc computer networks. Attack analysis and countermeasures will be studied at the transport, network, data link, and physical layers. Students will learn how to implement security and trust controls for malicious behavior prevention, detection, and recovery.

This set of three courses in the certification in Cybersecurity Technologies, will provide students with the specialized knowledge required to attack this problem domain.

How to Apply:
Fill out the online application for participation in the certificate program.

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Cybersecurity Technologies
CSTC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

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• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Admissions Requirements for the Graduate Certificate in Cybersecurity Technologies

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

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- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
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    - Earn a minimum IELTS score of 6.5.
    - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Cybersecurity Technologies

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

ECE 5484 Fundamentals of Computer Systems: Fundamental principles and concepts of computer systems. Computer hardware; Boolean logic; number systems and representation; design and operation of digital logic; analysis of instruction set architectures and computer organization; and specification of data communication and networking standards. Pre: Programming language experience (C++, C#, Java).

ECE 5585 IT Security and Trust I: Fundamental Internet and computer security principles and applications; legal and privacy issues, risk analysis, attack techniques, intrusion detection concepts, basic computer forensics, and system application hardening techniques. Pre: ECE 5484.

AND

ECE 5586 IT Security & Trust II: Advanced security and trust concepts and implementation in wired and wireless computer networks and computer systems, malware defenses, impact of channel fragility, node mobility, cooperative functionality, and resource constraints on security and trust at the different layers of the internet protocol stack. Pre: ECE 5585.

OR

ECE 5480 Cybersecurity and the Internet of Things: Cybersecurity principles and technologies motivated by the evolving ecosystem of the Internet of Things (IoT): devices, operating systems, sensors, data storage, networking and communication protocols, and system services. IoT device and system security and privacy vulnerabilities, analysis and attach mitigation techniques. Pre: ECE 5484 or CS 5044.

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Data Analytics
DAC

Address:
3060 Torgersen Hall, Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wanawsha Shalaby, Manager of Operations for the Discovery Analytics Center

Web Resource(s):
• Graduate Certificate in Data Analytics

Phone Number(s):

Graduate Certificate in Data Analytics

Description: The purpose of this certificate is to prepare students for technical careers in big data analytics and data science. Students will acquire in-depth technical skills that will enable them to understand the underlying technical fundamentals of data analytics, to develop new analytical methods, and to engineer new analytical tools. Students will acquire skills that integrate computational, statistical, and engineering techniques that form the heart of big data analytics. The certificate will provide students with formal recognition of their skills to better support their career prospects.

There is a growing need for technically trained engineers and scientists to lead the rapidly evolving field of big data analytics. The U.S. presidential administration has identified big data analytics as a core area of national need. Data science is one of the fastest growing career paths, and demand for technical expertise is out-pacing supply. Technical expertise is needed to develop new methods, tools, and infrastructures required to support novel big data analytics operations in industry, government, and academia. The technical expertise required involves a combination of computation, statistics, and engineering, such that training in any one of these individual disciplines alone does not suffice. This certificate will serve to train technical students with a broader view across these disciplines to support the data analytics field.

The learning outcomes of this certificate program are as follows:

(1) Students will have technical depth in the fundamentals of data analytics, in terms of understanding the underlying principles and implementations of analytical methods.

(2) Students will have broad understanding of multi-disciplinary perspectives on technical methods in data analytics, including computational, statistical, and engineering perspectives.

Target Audience and Time to Complete: The target audience of this certificate is technically oriented students in engineering and science. In particular, the certificate is ideally suited to complement the technical training of students enrolled in Virginia Tech's graduate programs in Computer Science, Statistics, and Electrical and Computer Engineering. Since the certificate requirements fit well with these existing degree program requirements, it is expected that the time to completion of the certificate will not substantially increase their time to completion for their degree program. Per university requirements, all 12 of the required credits for the certificate can be double counted toward a student's degree program. Students will need to take at least two additional courses beyond their existing degree requirements. However, students in other graduate programs at VT are not precluded. The estimated time to completion for students in other degree programs and for non-degree seeking participants is one year.

How to Apply:
Fill out the online application for participation in the certificate program.

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Data Analytics
DAC

Address:
3060 Torgersen Hall, Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wanawsha Shalaby, Manager of Operations for the Discovery Analytics Center

Web Resource(s):
• Graduate Certificate in Data Analytics

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Data Analytics

Admission:
Admission to the Graduate School and completing a Graduate Certificate Application are required for both degree- and non-degree seeking students.

Degree-seeking applicants:
The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better for admission to Certificate Status. Applicants with an undergraduate GPA < 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program. Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study.

Non-degree seeking applicants:
A qualified person who wishes to enter Virginia Tech to obtain a graduate certificate, without being enrolled in a degree program, may apply for graduate admission to Graduate Certificate status. Such applicants submit an Application for Admission and a Graduate Certificate Application https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Application_for_Graduate_Certificate_Program.pdf, and must meet the following criteria:

- GPA of 3.0 for admission for the last half of the credits earned for the undergraduate (bachelors) degree*
- official transcripts must be submitted.
- academic background meets the requirements of the admitting academic unit.
- International applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). A minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT) is required for consideration of the application. On the iBT, subscores of at least 20 on each subtest (Listening, Speaking, Reading, and Writing) are required for admission. A minimum IELTS score of 6.5 is required for admission. Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Graduate Certificate in Data Analytics

Curriculum Requirements and Descriptions
Number of Credit Hours:Students should complete at least 2 courses from the core list (see below) and 2 courses from the elective list, for a total of 12 credits. For all students, courses taken must span all three departments; Computer Science, Statistics and Electrical and Computer Engineering. All courses must be graded A-F, and

students must attain a minimum 3.0 GPA in the designated courses. Transfer credits are not permitted.

Core Courses: (Choose 2)

CS/STAT 5525 Data Analytics I

CS/STAT 5526 Data Analytics II

CS 5824/ECE 5424G: Advanced Machine Learning

Restricted Elective Courses: (Choose 2)

CS 5234 Advanced Parallel Computation

CS 5604 Information Storage and Retrieval

CS 5614 Database Management Systems

CS 5764 Information Visualization

CS 5804 Introduction to Artificial Intelligence

CS 5834 Introduction to Urban Computing

CS/ECE 6524 Deep Learning

CS 6604 Advanced Topics in Data and Information

STAT 5114 Statistical Inference

STAT 5314 Monte Carlo Methods in Statistics

STAT 5414 Time Series Analysis I

STAT 5444 Bayesian Statistics

STAT 5444G Advanced Applied Bayesian Statistics

STAT 5504 Multivariate Statistical Methods

STAT 5544 Spatial Statistics

ECE 5524 Pattern Recognition

ECE 5554 Computer Vision

ECE 5605 Signal Detection and Estimation

ECE 5734 Convex Optimization

ECE/CS 6524 Deep Learning

ECE 6554 Advanced Computer Vision

Graduate Certificate in Data Analytics

See the required certificate CheckSheet and FAQ at:https://sanghani.cs.vt.edu/academics/data-analytics/

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Disaster Resilience
DRGC

Address:
4044 Derring Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• DRRM Program

Web Resource(s):
• DRRM Webpage

Phone Number(s):
• *Robert Weiss, Director:* 540/231-2334

Disaster Resilience Graduate Certificate

The Graduate Certificate in Disaster Resilience is designed to teach students the full complexity of disaster risk and resilience at the intersections of science, engineering, social science, and public policy. This certificate program helps students overcome discipline-specific conceptualizations, and generate new transdisciplinary knowledge and solutions for achieving disaster resilience. Students will learn the limitations of disciplinary approaches to managing disaster and hazards risk, as well as the advantages of and approaches for integrating frameworks, methods, and perspectives used across disciplines. Students will also learn to conduct and evaluate case studies at different geographic scales, communication and critical vocabularies for effective stakeholder engagement, and collaborative skills needed for working effectively in interdisciplinary teams.
This certificate program is open to all graduate students at Virginia Tech.

How to Apply:
Fill out the online application for participation in the certificate program.

Disaster Resilience
DRGC

Address:
4044 Derring Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• DRRM Program

Web Resource(s):
• DRRM Webpage

Phone Number(s):
• *Robert Weiss, Director:* 540/231-2334

DRRM Admission Requirements

Degree-seeking or non-degree-seeking students will all have to apply to the certificate program.
Degree-seeking students will:

- Submit a Graduate Certificate Application
- Possess a bachelor's degree from an accredited institution with a GPA of 3.0 or better

Non-degree seeking students will:

- Submit a Graduate School Application for Admission
- Submit a Graduate Certificate Application
- Submit official transcripts
- Possess a bachelor's degree from an accredited institution with a GPA of 3.0 or better

Students who have not earned a degree in the United States must submit:

- Test of English as a Foreign Language (TOEFL) minimum score of 90 on the internet-based test (iBT) or the International English Language Testing System (IELTS) with a minimum score of 6.5
- TOEFL scores of 20 or greater in Listening, Writing, Speaking, and Reading subsections.

Program Requirements

Number of Credit Hours: **12 credit hours** of graduate level courses

Core Course – 3 credits

- GRAD 5034: Interdisciplinary Foundations of Disaster Resilience (3 credits)

Restricted Core Cross-discipline Electives – 6 credits.

The core discipline elective requirement includes a 3 credit course focusing on the technical and engineering aspect of disasters and hazards, and a 3 credit course focusing on public policy and social science aspect of disaster and hazards.
Technical and Engineering Core Elective (3 credits). Choose one from the following list:

- BIT 5474: Computer-based Decision Support Systems (3 credits)
- CEE 5594: Geological Engineering (3 credits)
- CEE 5854G: Advanced Coastal Engineering (3 credits)
- GEOS 6204: Advanced Topics in Sedimentology, when the course topic is simulation and modeling in geosciences (3 credits)

Policy and Social Science Core Elective (3 credits). Choose one from the following:

- SPIA 5124 Policy Decision-Making STEM-H (3 credits)
- UAP 5214: Topics in Natural Resources and Natural Hazards Planning, when the topic is disaster resilience and natural hazards mitigation (3 credits)
- UAP 5784: Economic Development Planning Topics, when the course topic is Community Resilience (3 credits)
- PAPA 5354: Homeland Security and Response and Recovery (3 credits)

Electives – 3 credits
Electives are intended to broaden students' understanding of disaster resilience and risk management. They can choose one technical course or one social science course from the following list or take an equivalent course approved by the DRRM faculty.

- BIT 5414: Operations Management in a Global Environment (3 credits)
- BIT 5474: Computer-based Decision Support Systems (3 credits)
- BIT 5494: International Operations and Information Technology (3 credits)
- CEE 5080: Infrastructure Asset Management (3 credits)
- CEE 5204: GIS Applications in Civil Engineering (3 credits)
- CEE 5464: Structural Dynamics & Earthquake Engineering (3 credits)
- CEE 5470: Structural Design for Seismic Load Effects (3 credits)
- CEE 5584: Geotechnical Aspects of Earthquake Engineering (3 credits)
- CEE 5594: Geological Engineering (3 credits)
- CEE 5660: Transportation Risk, Reliability & Security (3 credits)
- CEE 5854G: Advanced Coastal Engineering (3 credits)
- CEE 5734: Urban Hydrology & Storm-water Management (3 credits)
- CEE 5844: Ocean and Coastal Wave Mechanics (3 credits)
- CEE 5864: Coastal and Estuarine Morphodynamics (3 credits)
- ENGE 5024: Design in Engineering Education and Practice (3 credits)
- ENGE 5714: Topics in Engineering Education Research Methods (3 credits)
- ENGE 6714: Topics in Engineering Education Research and Practice (3 credits)
- GEOS 5154: Strong-Motion Seismology & Seismic Hazard Analysis (3 credits)
- GEOS 5714G: Advanced Volcanic Processes (3 credits)
- GEOS 6204: Advanced Topics in Sedimentology, when the course topic is simulation and modeling in geosciences (3 credits)
- PAPA 5254: Homeland Security & Terrorist Threat (3 credits)
- PAPA 5354: Homeland Security and Response and Recovery (3 credits)
- UAP 5084: Collaborative Planning and Community Involvement (3 credits)
- UAP 5134G: Advanced Land Use and Environment: Planning and Policy (3 credits)
- UAP 5214: Topics in Natural Resources and Natural Hazards Planning, when the topic is disaster resilience and natural hazards mitigation (3 credits)
- UAP 5364: Non-Governmental Organizations in International Development (3 credits)
- UAP 5414: Natural Resources Planning Topics, when the course topic is urban environmental policy, planning, and management in developing and transitional countries (3 credits)
- UAP 5784: Economic Development Planning Topics, when the course topic is Community Resilience (3 credits)
- UAP 5854G: Advanced Planning of the Urban Infrastructure (3 credits)

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Economic Development
ECDC

Address:
900 N Glebe Rd.
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• Margaret Cowell

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

Virginia Tech's Urban Affairs and Planning Program offers a Graduate Certificate in Economic Development. It is designed for those who are interested in acquiring a basic understanding of urban and regional economic development dynamics and the role of policy in influencing them.

Urban and regional planners need to know how they can develop their economies. The challenge for policymakers, economic developers and urban planners nowadays is to design appropriate local and regional economic development policies and programs to respond to challenges resulting from globalization, technological development, demographic changes, urban decline, sprawl, and social inequities.

How to Apply:
Fill out the online application for participation in the certificate program.

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Economic Development
ECDC

Address:
900 N Glebe Rd.
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• Margaret Cowell

Web Resource(s):
• Website

Phone Number(s):

Admission Requirements

Admission to the Certificate Program requires status as a graduate student in good standing at Virginia Tech, either as a current degree student or as a nondegree certificate student. A minimum undergraduate grade point average of 3.0 based on the last 60 semester hours of coursework is needed for admission to the Graduate School. Nondegree students whose undergraduate GPA was above 2.75 but below 3.00 may apply for admission under Commonwealth Campus status. Official transcripts must be submitted. Once admitted to the VT Graduate School, please fill out the following graduate certificate application form and submit it to the Graduate School:

Certificate Application:

https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Application_for_Graduate_Certificate_Program.pdf?nocache=1619113408356

Course Requirements

The Certificate requires the completion of a minimum of 12 credit hours of graduate course work. To receive the Certificate, students must have a minimum grade point average of 3.0 for the courses taken. Students seeking the Certificate must complete at least six credit hours from among the following courses plus six credit hours in electives.

UAP 5234: Urban Economy & Public Policy

UAP 5104: Urban & Regional Development Theory

UAP 5784: Local Economic Development Planning

UAP 5774: Economic Development Studio

All credits for the Certificate must be 5000- or 6000-level courses and must be graded on an A-F basis unless they are only offered on a Pass/Fail basis. All courses must be taken from programs in Virginia Tech's School of Public and International Affairs with at least nine in Urban Affairs and Planning. The Certificate is offered at both the Alexandria and the Blacksburg campuses.

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Economic Risk and Global Inequality
ERGC

Address:
1021 Prince St.
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):

Web Resource(s):

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

How to Apply:
Fill out the online application for participation in the certificate program.

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Economic Risk and Global Inequality ERGC

Address:
1021 Prince St.
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):

Web Resource(s):

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Course Requirements

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Educational Research
ERC

Address:
Educational Research and Evaluation, 1750 Kraft Drive, Corporate Research Center
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. David Kniola, EDRE Program Leader

Web Resource(s):
• EDRE Webpages (Section for EDRE Certificate)

Phone Number(s):
• *Dr. David Kniola:* 540/231-2246

Certificate Overview | Admissions & Course Requirements

Overview of the Certificate

The **Graduate Certificate in Educational Research and Evaluation (EDRE)** is designed to recognize graduate students who have acquired methodological expertise that goes beyond the methodological skills obtained in introductory methodology courses. More specifically, the certificate recognizes the completion of specialized coursework in evaluation/assessment, measurement, qualitative methods, and/or statistics. The certificate is also intended for students who already hold a graduate degree but who would like to obtain a credential in research methodology, to benefit their careers.

Learning Outcomes

The EDRE Graduate Certificate demonstrates that a graduate student has achieved a level of proficiency in research methodology that exceeds what is possible at an introductory level. Learning outcomes for the certificate include the following:

- Understand basic and advanced methodological concepts that are associated with evaluation/assessment, measurement, qualitative, and/or statistical research.
- Understand and effectively use a variety of methodological techniques and practices that are associated with evaluation/assessment, measurement, qualitative, and/or statistical research.
- Understand basic and advanced research design issues and effectively design an evaluation/assessment, measurement, qualitative, and/or statistical study.
- Develop an effective research proposal for evaluation/assessment, measurement, qualitative, and/or statistical research.
- Understand and effectively use a variety of data collection and data analysis methods and techniques that are associated with evaluation/assessment, measurement, qualitative, and/or statistical research.
- Develop an effective research report of evaluation/assessment, measurement, qualitative, and/or statistical research.
- Develop an effective oral and/or visual presentation of evaluation/assessment, measurement, qualitative, and/or statistical research.
- Understand and use appropriate criteria to effectively evaluate the quality of research proposals and research reports for evaluation/assessment, measurement, qualitative, and/or statistical research.

How to Apply for the EDRE Graduate Certificate:
Complete the online application for participation in the certificate program.

How to Apply:
Fill out the online application for participation in the certificate program.

Educational Research
ERC

Address:
Educational Research and Evaluation, 1750 Kraft Drive, Corporate Research Center
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. David Kniola, EDRE Program Leader

Web Resource(s):
• EDRE Webpages (Section for EDRE Certificate)

Phone Number(s):
• *Dr. David Kniola:* 540/231-2246

Admission Requirements

Graduate students who are accepted into any other graduate program at Virginia Tech will be admitted to the EDRE Graduate Certificate program on the basis of acceptance into their home department.

A recommendation for admission of nondegree-seeking students to the EDRE Graduate Certificate program will be made by the EDRE Graduate Admissions Committee based on academic transcripts, a letter of interest, and the minimum admission requirements that are specified in the Graduate Catalog. Please note that these admission requirements differ from the EDRE program's degree admission requirements in that GRE scores and letters of recommendation are not required.

After completing all of the EDRE Graduate Certificate requirements, a student must apply for the certificate using the *Graduate Certificate Application* form that is available from the Virginia Tech Graduate School website.

Course Requirements

Number of Credit Hours: The EDRE Graduate Certificate requires nine credit hours of specialized EDRE coursework. This excludes introductory EDRE courses (i.e., EDRE 6605 (Quantitative Research Methods in Education I), EDRE 6606 (Quantitative Research Methods in Education II), EDRE 6504 (Qualitative Methods in Education Research I), EDRE 6704 (Evaluation Methods in Education Research I), and all 5000-level EDRE courses other than EDRE 5644 (Questionnaire Design and Survey Research in Education)) that are prerequisites for specialized EDRE courses. Please note that EDRE 6634 (Advanced Statistics in Education - Regression) is required for all upper-level measurement and statistics courses and counts toward the certificate.

A grade of B or higher is required for each course that is used for the certificate; hence, courses that are audited or graded as Pass/Fail cannot be used for the certificate. Also, transfer credit or credit for courses that have been completed outside of the EDRE program is not permitted.

Recommended Combinations of Specialized EDRE Courses

Evaluation/Assessment: EDRE 5644, EDRE 6684, EDRE 6794 (Evaluation Methods in Education Research II), EDRE 6794 (Assessment in Higher Education)

Measurement: EDRE 6624, EDRE 6634, EDRE 6654, EDRE 6684, EDRE 6754, EDRE 6774

Qualitative Methods: EDRE 6524

Statistics: EDRE 6634, EDRE 6654, EDRE 6664, EDRE 6674, EDRE 6694, or a relevant Advanced Issues EDRE course

The section that follows includes a description of each course that can be used for the EDRE Graduate Certificate, as well as its prerequisite(s).

Courses That Can Be Used for the EDRE Graduate Certificate and Their Prerequisites

EDRE 5644

Questionnaire Design and Survey Research in Education (3H, 3C) (Pre: EDRE 5404)

This course provides an overview of survey research that is useful for gathering empirical data for non-experimental purposes in education and related settings. This project-based course focuses on questionnaire design including question formulation, sampling, data collection and analysis, and report writing.

EDRE 6524

Qualitative Methods in Education Research II (3H, 3C) (Pre: EDRE 6504)

Provides an advanced treatment of qualitative inquiry in education and the social sciences in general. It examines the theoretical orientations of major qualitative research traditions and provides students with advanced skills in data analysis and other phases of inquiry. Offered spring, yearly.

EDRE 6624

Measurement Theory in Education (3H, 3C) (Pre: EDRE 6634)

Methods and theories of estimating and enhancing test score characteristics, particularly reliability and validity of aptitude and achievement tests. Problems associated with test construction, use, and score interpretation will be emphasized. Offered spring, yearly.

EDRE 6634

Advanced Statistics for Education (3H, 3C) (Pre: EDRE 6606)

Multiple regression procedures for analyzing data as applied in educational settings, including curvilinear regressions, dummy variables, multicollinearity, and introduction to path analysis. Offered fall and spring, yearly.

EDRE 6654

Multivariate Statistics for Applications to Educational Problems (3H, 3C)(Pre: EDRE 6634)

Multivariate statistical procedures presented in an applied research setting. Oriented toward the logical extension of univariate tests of significance and estimation procedures to multivariate problems. Emphasis on using existing computer software packages. Offered spring, yearly.

EDRE 6664

Applications of Structural Equations in Education (3H, 3C) (Pre: EDRE 6634)

Applications of structural equation causal models in educational research and discussion of the methodological questions pertaining to such models. Topics include recursive and nonrecursive models, measurement errors in causal models, latent unobserved variables, and covariance structures. Offered fall and spring, yearly.

EDRE 6674

Longitudinal Data Analysis (3H, 3C) (Pre: EDRE 6634)

Introduction to longitudinal data analysis (LDA) as applied to the behavioral and social sciences, including education, psychology, human development, sociology, and health sciences. Topics covered include

advanced methods of LDA such as growth models in hierarchical linear modeling (or multilevel modeling), latent curve models in structural equation modeling, and econometric fixed effects models. Other methods will be covered when appropriate.

EDRE 6684

Instrument Development and Validation (3H, 3C) (Pre: EDRE 6634)

Provides experience in developing instruments, or tests, that are designed to measure educational and psychological constructs, such as knowledge, skills, attitudes, and traits. Issues and practices related to construct specification, instrument design and administration, and analysis and summary of validity study data are emphasized. Offered fall, yearly.

EDRE 6694

Hierarchical Linear Modeling (3H, 3C) (Pre: EDRE 6634)

Provides a conceptual framework of hierarchical linear modeling (HLM), some important statistical theory behind the HLM, and hands-on training for applying HLM techniques through analyzing example data sets and projects. The course includes the formulation of statistical models for typical applications such as two-level organizational study, two-level growth model, and three-level growth model within contexts and prepares students to be able to use multilevel analysis to address research questions in their fields and write coherent summaries and interpretations of the results. Offered fall, yearly.

EDRE 6754

Advanced Item Response Theory (3H, 3C) (Pre: EDRE 6624 or EDRE 6684)

Provides students with the concepts and skills to carry out Item Response Theory (IRT) analyses using specialized software, and an introduction to research in measurement. Topics will include binary and polytomous models, item and ability parameter estimation, model fit, and scaling and equating. Offered every other year, spring.

EDRE 6774

Advanced Issues in Psychometric Research (3H, 3C) (Pre: EDRE 6624 or EDRE 6684)

Provides an in-depth examination of one or more research topics in psychometrics, or the statistical foundations of educational and psychological tests. Students will become familiar with current research, acquire specialized psychometric analysis skills, and learn how to conduct psychometric research. Topics covered may vary from term to term. May be repeated for a maximum of 12 credits. Offered irregularly, spring.

EDRE 6794

Advanced Topics in Educational Research (3H, 3C) (Pre: varies)

Advanced treatment beyond standard courses in topics such as questionnaire design, survey sampling, factor analysis, and meta analysis. May be repeated with different topics for up to 6 hours of credit.

EDRE 6794

Evaluation Methods in Education Research II (3H, 3C) (Pre: EDRE 6704)

EDRE 6794

Assessment in Higher Education (3H, 3C) (Pre: EDRE 6704)

Designed to provide an overview of theoretical, philosophical, practical, and policy issues that are appropriate to outcomes assessment methodology in higher education and that are transferable to other

educational and non-governmental settings. The course emphasizes understanding of assessment to enhance the educational environment and support academic quality.

Certificate Application Form

EDRE Grad Certificate Application Form

Additional Application Materials

The EDRE program is required to assess the knowledge and skills that students acquire from coursework that is completed for the EDRE Graduate Certificate. This requirement involves an additional step in the certificate application process, but several options are available. You can submit either an empirical or a non-empirical work sample as part of your application. Please note that the work sample submitted must have been completed within the last two years and must be (a) a methodologically-oriented paper from one of the courses that you have taken for the EDRE Graduate Certificate, (b) a conference paper, or (c) a manuscript that has been submitted to an academic journal for review or that is in press or in print with an academic journal.

The work sample that you submit will be evaluated by an EDRE faculty member who has relevant expertise, using the appropriate criteria that are discussed below. Please note that a minimum score is not stipulated for this evaluation.

Learning Outcome #1

The student will be able to understand, apply, and/or evaluate a specific research paradigm, research methodology, data collection method, or data analysis method.

The methodological portion of an empirical work sample will be evaluated using a five-point scale:

1) Was the research methodology that was used appropriate for investigating the research problem and/or research question(s)?

2) Was the research methodology understood and used correctly?

A non-empirical work sample will be evaluated using a five-point scale:

1) Was the research paradigm, research methodology, data collection method, and/or data analysis method described/explained accurately?

2) If relevant, was the research paradigm, research methodology, data collection method, and/or data analysis method critiqued/evaluated effectively?

Learning Outcome #2

The student will be able to understand and/or apply fundamental methodological concepts that are associated with a specific research paradigm, research methodology, data collection method, or data analysis method (e.g., validity, reliability, generalizability, HLM, SEM, or IRT, as they are understood within a specific methodological tradition).

The Results, Discussion, Limitations, and Conclusion sections of an empirical work sample will be evaluated using a five-point scale:

1) Were the results interpreted correctly?

2) Were the results discussed in relationship to the stated research problem and/or research

question(s)?

3) Did the above sections of the work sample demonstrate an understanding of, and adherence to, the methodological requirements for validity, reliability, generalizability, and/or other fundamental methodological concepts (e.g., those that are associated with HLM, SEM, or IRT)?

A non-empirical work sample will be evaluated using a five-point scale:

1) Were fundamental methodological concepts described/explained accurately?

2) If relevant, were fundamental methodological concepts critiqued/evaluated effectively?

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Engineering Education
ENGC

Address:
Department of Engineering Education (0218)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Tamara Knott
• Walter Lee

Web Resource(s):
• Website

Phone Number(s):
• *Department Receptionist:*
540/231-6555
• *Department Graduate Coordinator:*
540/231-9543

Certificate Overview | Admissions & Course Requirements

Certificate Overview

Our Graduate Certificate in Engineering Education is popular with students from across the College of Engineering. Requiring 12 credits, the certificate is complementary to graduate study in a traditional engineering discipline and serves to brand the recipient as someone who has made the decision to learn more about education of engineering students. The certificate is also complementary to the Future Professoriate Graduate Certificate offered by the Graduate School in the sense that with careful selection of electives, students can earn both certificates at the same time.

The Certificate program is designed for graduate students in engineering and related disciplines interested in engineering education who wish to explore teaching practices specific to engineering courses**.**

How to Apply:
Fill out the online application for participation in the certificate program.

Engineering Education
ENGC

Address:
Department of Engineering Education (0218)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Tamara Knott
• Walter Lee

Web Resource(s):
• Website

Phone Number(s):
• *Department Receptionist:*
540/231-6555
• *Department Graduate Coordinator:*
540/231-9543

Admission Requirements

Graduate students wishing to earn the graduate Certificate in Engineering Education must be currently enrolled (not provisional) masters or doctoral students in good standing in any Virginia Tech discipline or major. For admission to the Certificate program, applicants must also satisfy at least one of three requirements:

- Enrollment in a graduate program in the College of Engineering, or
- Bachelor’s degree in any field of engineering, or
- Bachelor’s degree in the physical or biological sciences or mathematics

Applicants who do not meet any of the three requirements may request special consideration from the ENGE Graduate Committee by submitting a brief statement detailing your interests, experiences, and/or connections to engineering which motivate you to pursue the certificate.

Course Requirements

To earn the Certificate, graduate students must complete a minimum of 12 graduate credits, all of which must be taken for a letter grade, with the exception of 1 credit seminar courses.

Six (6) Credits of Required Core Courses:

ENGE 5304: Graduate Student Success in Multicultural Environments (1 credit)

ENGE 5214: Issues in Engineering Education (2 credits)

ENGE 5504: Practicum (3 credits) OR Special Substitution

Six (6) Credits of Elective Courses:

Any 3-credit course with an ENGE prefix will count toward this elective requirement.

Students may also choose to use approved courses from the Graduate School or the School of Education to count towards this elective requirement. Examples of non-ENGE courses include the following:

EDEP 5114: Learning and Cognition (3 credits)

EDEP 6444: Motivation and Cognition (3 credits)

EDEP 6644: College Teaching (3 credits)

EDHE 6424: Institutional Effectiveness & Outcome Assessment in Higher Education (3 credits)

EDIT 5164: Design for Learning (3 credits)

EDIT 5274: Foundations of Instructional Design and Theory (3 credits)

EDRE 5404: Foundations of Educational Research & Evaluation (3 credits)

EDRE 5644: Questionnaire Design and Survey Research in Education

EDRE 6605-6606: Quantitative Research Methods in Education I & II (3 credits each)

EDRE 6504: Qualitative Methods in Educational Research I (3 credits)

EDHE 6424: Institutional Effectiveness & Outcome Assessment in Higher Education (3 credits)

GRAD 5104: Preparing the Future Professoriate (3 credits)

GRAD 5984: Critically Engaged Teaching with Advanced Technology (3 credits)

STS 6614: Advanced Topics in Technology Studies (Engineering only) (3 credits)

Students may request to the ENGE Graduate Committee that other courses be approved as electives.

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Entrepreneurship in Hospitality and Tourism Management
EHTC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Professor Mahmood Khan

Web Resource(s):
• Website

Phone Number(s):
• *Mahmood Khan:* 703/538-8486

Certificate Overview | Admissions & Course Requirements

Entrepreneurship in Hospitality and Tourism Management Overview

Applications for the Graduate Certificate in Entrepreneurship in Hospitality and Tourism Management will be considered from students enrolled in a graduate degree program at Virginia Tech and from non-degree and Commonwealth Campus students who have undergraduate degrees. Certificates will be awarded upon application for the certificate once course requirements have been completed. The certificate has been designed so that both degree and non-degree seeking students from other majors may take the three courses within one semester and complete the certificate.

New entrepreneurs often possess innovative ideas but lack the business skills that will make them successful. Entrepreneurs differ from other business start-ups in that they are creating a unique and ground-breaking approach to a business. They have unique approaches, different business models, and/or innovative delivery techniques. The purpose of this certificate is to provide students with the specific tools and skills required to prepare them to engage in entrepreneurial activities in Hospitality and Tourism management. Specifically, this certificate will help students create a business plan that includes the financial, human resource, and leadership components vital for their success. What makes the program unique is the inclusion of an optional franchising course to provide students with the expertise needed to consider moving beyond their initial start-up to becoming a franchise in the future.

Upon completion, participants will be able to:

- Create a business plan tailored to entrepreneurial endeavors in Hospitality and Tourism Management;
- Analyze the practical leadership, marketing, financial, and production considerations for a variety of entrepreneurial initiatives for both new ventures and established firms in Hospitality and Tourism Management;
- Analyze and critique both past and current approaches to entrepreneurial leadership;
- Analyze human resources issues relevant to entrepreneurial activities in hospitality and tourism management;
- Apply the processes, practices and legal considerations of entrepreneurial endeavors in hospitality and tourism to real-time cases;
- Analyze and critique the various approaches to franchise concept development, the franchisor-franchisee relationship, franchise agreements, operational problems, and international franchising;
- Apply fundamentals of financial management to cases of entrepreneurial hotels, restaurants, institutions and similar service opportunities

How to Apply:
Fill out the online application for participation in the certificate program.

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Entrepreneurship in Hospitality and Tourism Management
EHTC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Professor Mahmood Khan

Web Resource(s):
• Website

Phone Number(s):
• *Mahmood Khan:* 703/538-8486

Certificate Overview | Admissions & Course Requirements

Entrepreneurship in Hospitality and Tourism Management Admission Requirements

Graduate certificates can be awarded to individuals who do not desire to work toward a degree as well as to students who are working on graduate degrees. Interested students must submit an official copy of their college transcript or diploma documenting receipt of a bachelor's degree from a regionally accredited college or university with an acceptable grade point average mailed to the Virginia Tech Graduate School as part of the application process. Please contact us for specific instructions on applying online. Students should meet with the MSBA-HTM and Graduate Certificates Advisor and submit the application form to the HTM Graduate Administrator for Certificate Program Approval signature no less than six months prior to completion of coursework.

Entrepreneurship in Hospitality and Tourism Management Curriculum Requirements

Number of Credit Hours: 9 credit hours. Transfer credits are not permitted.

Required Course:

MGT 5814 Entrepreneurial Leadership. This course discusses the concepts and techniques for providing leadership in the entrepreneurial venture. It provides the theoretical basis for understanding the entrepreneurial process in the economy. It discusses the practical leadership, marketing, financial, and production considerations for entrepreneurial initiatives for new ventures and established firms. (3H, 3C)

Restricted Elective Courses:

Choose two of the following:

HTM 5424 Human Resource Management. This course focuses upon the attainment and retainment of employees within the hospitality industry. Topics include the processes, practices and legal considerations involved in the employment of people in hospitality organizations. (3H, 3C)

HTM 5464 Franchising in Hospitality Management. Role of franchising in hospitality management. Contemporary issues related to franchising in different segments of hospitality industry, including franchise concept development, franchisor-franchisee relationship, franchise agreements, operational problems, and international franchising. (3H, 3C)

HTM 5444 Financial Management in the Hospitality Service Industries. Fundamentals of financial management as applied to hotel, restaurants, institutions and similar service organizations. (3H, 3C)

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Environmental Politics & Policy
PEPC

Address:
Political Science (0130) Major Williams Hall Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Virginia Tech Online

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This graduate certificate in Environmental Politics and Policy is designed for non-degree-seeking students and graduate students at Virginia Tech who wish to demonstrate special competence in the research area of environmental politics and policy. Protecting the environment and enhancing the quality and sustainability of human-nature interactions has become a critical goal for federal and state agencies, as well as numerous companies working in all sectors of the economy. Because professionals and researchers working to address these challenges must work closely with policymakers or the policy process, public, nongovernmental and private employers increasingly require individuals who are familiar with the policy-making process. Certificate provides skills in these areas, especially in relation to climate change, social adaptation of human communities, the protection of 'wild' nature, renewable and sustainable energy efforts, and environmental and climate justice. This certificate program responds to an existing demand by degree-seeking and non-degree students, studying on campus or through on-line courses. The certificate recognizes coursework that students have completed that demonstrates a focus on environmental politics and policy.

How to Apply:
Fill out the online application for participation in the certificate program.

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Environmental Politics & Policy
PEPC

Address:
Political Science (0130) Major Williams Hall Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Virginia Tech Online

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Admission Requirements

Applications for the Graduate Certificate in Environmental Politics and Policy will be considered from students enrolled in a graduate degree program at Virginia Tech and from non-degree and Commonwealth Campus students who have undergraduate degrees. Certificates will be awarded upon application for the certificate and application for certificate conferral once course requirements have been completed.

Course Requirements

The certificate requires successful completion of a total of twelve credit hours, of which 9 credits are required courses and 3 are elective. Students need to receive a grade of B or better in each course to receive the certificate. Students will not be allowed to retake a course for a better grade if they receive below a B. All courses are for 3 credit hours. All students must complete:

* PSCI 5214 Contemporary Political Theory or PSCI 5115 Research Methods I **and**
* PSCI 5364 Public Ecology
* PSCI 5584 Environmental Politics and Policy

In addition, students must complete at least 3 credit hours from the following:

* PSCI 5354 Public Policy Analysis
* PSCI 5414 Industrial Democracies
* PSCI 5434 Politics of Developing Areas
* PSCI 5314 Legislative Branch
* PSCI 5324 Executive Branch
* PSCI 5334 Judicial Branch

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Europe and Transatlantic Relations
ETRC

Address:
119 Major Williams Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):

Phone Number(s):
• *General Contact:* 540/231-6572

Certificate Overview | Admissions & Course Requirements

Europe and Transatlantic Relations Overview

The proposed Graduate Certificate in Europe and Transatlantic Relations is designed to teach students the fundamental principles of transatlantic relations with countries in Europe. The Global Europe Program scholars state, “The United States and Europe are bound by dense societal, cultural, economic, political, and security ties. The transatlantic relationship has been the anchor of global order.”1 Further, “the interdependence of the world’s economies, cultures, and populations, brought about by cross-border trade in goods and services, technology, and flows of investment, people, and information,”2 has created both positive and negative implications for the United States.
Students will examine how the domestic policies and national interests of the United States (U.S.) affect its interactions with its allies in Europe. Students will develop an understanding of the European Union (EU) and its 27 countries, legal system, institutions (i.e., European Council, European Parliament), economy, and major internal and external policies. Students will develop knowledge of the political and economic causes of tensions and conflict between the U.S. and its European allies. Graduates will be able to analyze how domestic political and security changes affect relations between the U.S. and Europe. Graduates will also be able to evaluate Europe’s economic policies, the impacts on transatlantic relations, and inform decisions made by businesses such as banks in the United States.

How to Apply:
Fill out the online application for participation in the certificate program.

Europe and Transatlantic Relations
ETRC

Address:
119 Major Williams Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):

Phone Number(s):
• *General Contact:* 540/231-6572

Europe and Transatlantic Relations Admission Requirements

Applications for the Graduate Certificate in Security Studies will be considered from students enrolled in a graduate degree program at Virginia Tech and from non-degree and Commonwealth Campus students who have been permitted to take courses by the Graduate School. Certificates will be awarded upon application for the certificate and application for certificate conferral once course requirements have been completed.

Europe and Transatlantic Relations Course Requirements

Number of Credit Hours: 12 credit hours. *New courses are designated with an asterisk (*).*Core Courses: 6 credits

- PSCI/GIA 5704: Transatlantic Relations (3 credits)*
- PSCI/GIA 5714: European Union (3 credits)*

Restricted Elective Courses: 6 credits. Students must select courses from the following list of courses.

- PSCI/GIA 5414: Industrial Democracies (3 credits)
- PSCI/GIA 5424: Communist and Post-communist Systems (3 credits)
- PSCI/GIA 5724: European Political Economy (3 credits)*
- PSCI/GIA 5734: European Politics & Society (3 credits)*
- PSCI/GIA 5744: European Security (3 credits)*
- PSCI/GIA 6154: Topics in European Politics (3 credits)*
- PSCI/GIA 6164: Topics in Transatlantic Relations (3 credits)*
- PSCI/GIA 6174: Topics in EU Policies (3 credits)*
- PSCI/GIA 6184: Topics in European Security (3 credits)*

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Foundations of Political Analysis
PPAC

Address:
Political Science (0130) Major Williams Hall Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Website

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Certificate Overview

This graduate certificate program is designed for non-degree-seeking students and graduate students at Virginia Tech who wish to demonstrate special competence in the foundations of political analysis. The ability to evaluate contemporary politics requires a solid understanding of how thinkers in the past addressed the politics of their times and places. In addition to canonical Western sequences, students will engage with work in Latin American-New World and Eastern traditions, as well as postcolonial and decolonial thought, democratic theory and American and Continental strands of critical theory. This certificate responds to an existing demand by degree-seeking and non-degree students, studying on campus or on-line. It will recognize courses that students successfully complete as they focus on developing a foundation in political analysis in political science.

How to Apply:
Fill out the online application for participation in the certificate program.

Foundations of Political Analysis
PPAC

Address:
Political Science (0130) Major Williams Hall Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Website

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Admission Requirements

Applications for the Graduate Certificate in Foundations of Political Analysis will be considered from students enrolled in a graduate degree program at Virginia Tech and from non-degree and Commonwealth Campus students who have been permitted to take courses by the Graduate School. Certificates will be awarded upon application for the certificate and application for certificate conferral once course requirements have been completed.

Course Requirements

The certificate requires successful completion of a total of twelve credit hours, of which 9 credits are required courses and 3 are elective. Students need to receive a grade of B or better in each course to receive the certificate. Students will not be allowed to retake a course for a better grade if they receive below a B. All course are for 3 credit hours. All students must complete:

* PSCI 5214 Contemporary Political Theory
* PSCI 5115 Research Methods I
* PSCI 5116 Research Methods II

In addition, students must complete at least 3 credit hours of Political Science graduate course offerings from:

- PSCI 5344 - Political Behavior
- PSCI 5504 - Discourse Analysis

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Future Professoriate
FPGC

Address:
Graduate Life Center at Donaldson Brown (0325)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Graduate Admissions and Academic Progress

Web Resource(s):
• Website

Phone Number(s):
• *Graduate Admissions and Academic Progress:* 540/231-8636

Certificate Overview | Admissions & Course Requirements

Future Professoriate Graduate Certificate

For graduate students preparing to become faculty.
This graduate certificate aims to prepare graduate students to become our future faculty and academic leaders by exposure to concepts that break the mold of existing practices in higher education. Many leaders in the academic and business communities have recently challenged colleges and universities to embrace change in order to ensure the viability of the higher education enterprise. Rather than settle for the status quo and witness a probable decline in sustainability, most argue that it is time to create new models and new methods of training for the future professoriate, who will become the faculty and academic leaders of tomorrow.

This certificate is part of the overarching theme "Transformative Graduate Education" (TGE). Interconnecting components all serve to better prepare the next generations for the professoriate and career professionals.

- Preparing the Future Professoriate
- Preparing the Future Professional
- GEDI – enhancing the GTA and professional development experience that encourages graduate students to acquire a broad array of skill sets that will prepare them to be teacher/scholar/professionals who are better able to meet the higher education and societal challenges of the 21st century. This project is being conducted in collaboration with Learning Technologies
- Citizen-Scholar Program – addressing the impact of rigorous intellectual scholarship, leadership and policy beyond the educational realm.

How to Apply:
Fill out the online application for participation in the certificate program.

Future Professoriate
FPGC

Address:
Graduate Life Center at Donaldson Brown (0325)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Graduate Admissions and Academic Progress

Web Resource(s):
• Website

Phone Number(s):
• *Graduate Admissions and Academic Progress:* 540/231-8636

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Graduate students wishing to earn the graduate certificate in Future Professoriate must be currently enrolled master's or doctoral students in any discipline or major. These individuals must have satisfied all admissions requirements to be admitted and must remain in good academic standing.

Course Requirements

Graduate students must complete a minimum of 9 graduate credits (6 of which must be graded graduate credits). Required **core** courses include (6 credit hours):

GRAD 5104 Preparing the Future Professoriate (3 hours/3 credits)
GRAD 5114 Pedagogical Practices in Contemporary Contexts (3 hours/3 credits)

To satisfy the additional 3 credits, interested students can selected from this list of approved courses including the following courses offered by the Graduate School:

- GRAD 5004 GTA Workshop (1 credit hour)
- GRAD 5014 Academic Integrity and Plagiarism (1)
- GRAD 5124 Library Research Skills (1)
- GRAD 5204 Citizen Scholar Seminar (3)
- GRAD 5214 Diversity and Inclusion in a Global Society (3)
- GRAD 5144 Communicating Science (2)
- GRAD 5954 Study Abroad - Future Professoriate Global Perspectives (3)

If you are interested in completing the Future Professoriate Graduate Certificate, please submit the Graduate Certificate Application to formally enroll in the certificate program. When all certificate requirements have been satisfied, please then submit the Application for Degree or Certificate Conferral to authorize the issuing of the diploma and the posting of the graduate certificate on your official transcript.

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Geospatial Information Technology
GITC

Address:
Department of Geography, 221 Wallace Hall, Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Santosh Rijal

Web Resource(s):

Phone Number(s):
• *Santosh Rijal:*
540/232-8450

Certificate Overview | Admissions & Course Requirements

Certificate Overview

Geospatial Information Technology (GIT) includes collection and analysis of remotely sensed data, digital spatial and attribute data used by geographic information systems (GIS), and the application of related technologies such as the Global Positioning System (GPS). Geographic Information Science is one of the leading careers in the United States today.

As depth of knowledge is important to careers in the industry, this certificate requires 12 hours of geospatial coursework. Coursework is taken from one or two categories, beginning with up to two introductory topics if needed, and continuing through more advanced and specialized topics as best fit the student's background and future goals.

How to Apply:
Fill out the online application for participation in the certificate program.

Geospatial Information Technology
GITC

Address:
Department of Geography, 221 Wallace Hall, Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Santosh Rijal

Web Resource(s):

Phone Number(s):
• *Santosh Rijal:* 540/232-8450

Admission Requirements & Procedure

Virginia Tech students accepted in any graduate program category: PhD., MS, MA, Commonwealth Campus, or Non-Degree can be admitted into the GIT program by completing the Graduate Certificate Application, and completing a plan for taking courses required on the course checklist below. Students should meet with an academic adviser familiar with the classes on the list below and submit the application form to Dr. Santosh Rijal for Certificate Program Approval signature no fewer than six months prior to completion of coursework.

Specific steps in the process are:

1. meet with or discuss the choice of acceptable courses with an adviser knowledgeable of the GIT coursework on campus (suggestions are below in additional information),
2. fill out and pass the certificate application form to Dr.Santosh Rijal for signature.
3. submit the signed form to the Graduate School no fewer than six months prior to completion of course requirements,
4. complete 12 hours from the course requirements list below, and
5. submit the completed course check sheet and an unofficial copy of the transcript along with the Application for Degree or Certificate Conferral form to Dr.Santosh Rijal, chair of the Oversight Committee, for a signature, and then take Application for Certificate Conferral Form to the Graduate School.

Course Requirements

Below are the current courses approved for the certificate. Each year additional courses are added in the departments and those will be considered for the certificate if you make a request on your course plan form.

A. Introductory Courses: (0 - 6 credits to cover prerequisites for courses below)

- BSE 5344G - Applied Geographic Information Systems
  Conceptual, technical, and operational aspects of geographic information systems as a tool for storage, analysis, and presentation of spatial information. Focus on engineering applications in resource management, site selection, and network analysis. Laboratory work required. Graduate standing required.

- CEE 5204 - GIS Applications in Civil Engineering
  Examination of data structures used in geographic information systems. Map projections and coordinate systems used in mapping. Database creation, maintenance, and integrity. Applications of GIS methods for solving civil engineering problems in land management and related areas.

- FREC 5114G - Advanced Information Technologies for Natural Resource Management
  Course will introduce students to the theory and applications of database management systems (DBMS) and geographic information systems (GIS). Uses, challenges, and limitations of these technologies in natural resource management application will be discussed.

- FREC 5254 - Remote Sensing of Natural Resources
  Philosophy and rationale of remote sensing as a part of the resource management process; comparisons of analogic and digital sensors; sensor selection and proper use; accuracy assessment; signature development; and identification of factors which affect the quality of remotely sensed information.

- GEOG 5064 - Elements of GIS
  Foundations and applications of Geographic Information Systems (GIS); geographic coordinate systems, Cartesian map projections, spatial data sources, efficient GIS data structures, map representations, and spatial applications of GIS. Pre: Graduate Standing.

- GEOG 5354G - Advanced Remote Sensing
  Theory and methods of remote sensing. Practical exercises in interpretation of aerial photography, satellite, radar, and thermal infrared imagery. Digital analysis, image classification, and evaluation. Applications in earth sciences, hydrology, plant sciences, and land use studies. Field project and report. Review of current research literature. Graduate standing required.

- LAR 5044 - Land Analysis and Site Planning
  Introduction to the concepts and methods of ecological resource survey and analysis at regional and site scales. Approaches to environmental problem solving with an emphasis on data collection, evaluation, and synthesis using applicable technologies such as geographic information systems. Interpretation of landscape resource data for the purpose of physical planning and design.

- UAP 5114 - Computer Applications in Urban Planning and Management
  An examination of a wide range of computer-based techniques that are of value in analyzing urban and regional planning and management problems. Techniques include linear programming, goal programming; modeling of complex systems; and decision modeling. May be repeated with different content for a maximum of 12 credits. (cannot be repeated for credit in the certificate program)

B. Advanced Courses: (6 -12 credit hours)

- CEE 5224 - Advanced GIS Applications in Civil and Environmental Engineering
  This project based course deals with both vector and raster Geographic Information Systems (GIS), network analysis, tracking applications, hydrologic applications, spatial analysis, web databases, and linking GIS to models with programming, specifically in the civil and environmental engneering arena. Pre: Any introductory GIS course, including CEE 5204, GEOG 4084, or BSE 4344. Pre: Graduate standing.

- CEE 5244 - Advanced GIS in Hydrologic Analysis
  Advanced GIS course focusing on raster analysis with particular application to the issues associated with hydrologic analysis. Application and evaluation of algorithms for terrain analysis, watershed characterization, and hydrologic analysis and modeling as implemented in GIS. Digital elevation data sources and error assessment. Approaches to GIS/model integration and application. Pre:Graduate standing.

- CS 6604 - Advanced Topics in Data and Information
  This course treats a specific advanced topic of current research interest in the area of data and information. Papers from the current literature or research monographs are likely to be used instead of a textbook. Student participation in a seminar style format may be expected. Prerequisite(s): CS 5604 (UG) OR CS 5614 (UG) OR CS 5604 OR CS 5614

- FREC 5104 (GEOG 5104) - Seminar in Remote Sensing & Geographic Information Systems
  Interdisciplinary seminar devoted to current research in the fields of remote sensing, Geographic Information Systems, and related topics. Seminars, workshops, and presentations conducted by students, faculty, and visitors. Pre: Graduate standing.

- FREC 5154 - Hyperspectral Remote Sensing
  Theory of spectroscopy and spectrometry from portable spectroradiometers to airborne and spaceborne hyperspectral sensors as relevant to natural resource applications, including vegetation species indentification and vegetative health, soil and peat properties, mineral and geothermal characteristics, and water applications. Practical investigation of research tools and techniques used to analyze hyperspectral data. Pre-requisite: Graduate Standing Required

- FREC 6214 - Forestry Lidar Applications
  Theoretical underpinning of established and emerging research using light detection and ranging (lidar) technology for forestry applications including detailed terrain mapping and digital elevation models, canopy height modeling, prediction of forest biophysical parameters, forest physiology and the canopy light regime, watershed mapping and stream modeling, ecological modeling, landsca[pe classifications, and wildlife

habitat. Advanced research tools and techniques used to analyze lidar data for different applications. Graduate standing required.

- GEOG 5034 - Analysis of Spatial Data
  Methods of describing and analyzing spatial distributions, including spatial autocorrelation, quadrat analysis, trend surface analysis, and methods of map comparison. Applications to student research problems.

- GEOG 5084G - Advanced Modeling with Geographic Information Systems
  Use of automated systems for geographic data collection, digitization, storage, display, modeling and analysis. Basic data flow in GIS modeling applications. Development of proficiency in the use of current GIS software. Pre: Graduate Standing.

- GEOG 5114 - Geospatial Programming and Environmental ConservationCommon programming techniques with emphasis on application to remotely sensed and geospatial data. Input/output and formatting. Raster and feature operations from a command line using serial and parallel processing methods. Management and integration of large and varied datasets with emphasis on incorporating new data. Pre: Graduate standing

- GEOG 5124 - Aerial Photointerpretation and Analysis
  Principles, history, and methods of aerial photographic interpretation. Introduction to photographic systems and application to aerial photography. Human dimension to photointerpretation. Applications to varied fields of knowledge such as land-use mapping, earth sciences, forestry, agriculture, history and archaeology, and military and strategic studies

- GEOG 5314G - Advanced Spatial Analysis in Geographic Information SystemsTheory and application of geographic information systems. Spatial data handling and analysis to facilitate decision-making through the communication of geographic information. Development of such systems from existing data sources using both packaged and student produced software systems..
- GEOG 5334G - Advanced Geospatial Information Technology for Land Change Modeling
  Analysis of the spatio-temporal patters of land use and Land Cover Change (LULCC) as observed in satellite images. Tropical deforestation, urbanization, and agricultural intensification. Rates and patterns of LULCC linked to biophysical and socio-economic drivers. Impacts of land change with respect to local climate, biodiversity, water yield and quality, and ecosystem services.

- GEOG 5374G - Adv Remote Sensing & Phenology
  This course focuses on the analysis of the spatio-temporal of the vegetated land surface as observed in satellite images. Phenological events, such as the first openings of leaf and flower buds, are good indicators of the impact of local and global climate change. The focus of this course will beon satellite image time series used in the derivation of land surface phenology, the appearance and development of phenology other global regions, and the methods developed for the monitoring of phenology with satellite imagery. A major theme will be causes of spatio-temporal changes of phenological events and the effect of global climate change. Pre-requisite: Graduate Standing required

- GEOG 5384 - Programming for Geographic Information Systems
  Computational methods of map analysis with the ArcGIS Geographic Information System. Scripting and Visual Basic.NET programming using Environmentatl Systems Research Institute's ArcObjects library for customization of GIS software to meet research and analytical needs for both the desktop and the web. Pre: 5084G and computer programing experience.

- GEOG 5394G - Web Mapping
  Use of web mapping technologies for geographic data collection, storage, analysis, and display. Web mapping topics include history and context, spatial data infrastructures, hardware and software architectures, Open Geospatial Consortium standards, mapping API's, virtual globes, user-centric design, web cartography. Pre: Graduate standing.

- GEOG 5404G - Advanced GeovisualizationAdvanced topics in digital and dynamic map production, emphasizing concepts in advanced cartographic design, information visualization, and human-computer interaction. Topics include cartograms, computer aided design, animation, lidar and photogrammetric point cloud visualization, Web Geographic Information Systems, terrain visualization, and virtual geographic environments. Pre: Graduate standing.

- NR 6104 - Advanced Topics in Remote Sensing
  In-depth coverage of advanced topics in the field of remote sensing selected to cover emerging techniques and technologies. Examples of topics, which will differ each semester, include field data in support of remote sensing, accuracy assessment, and hyperspectral remote sensing. Critical assessment of the ways in which remotely sensed data and information are employed in varied scientific disciplines and by society.

- STAT 5544 - Spatial Statistics
  Spatial data structures: geostatistical data, lattices and point patterns. Stationary and isotropic random fields. Autocorrelated data structures. Semivariogram estimation and spatial prediction for geostatistical data. Mapped and sampled point patterns. Regular, completely random and clustered point processes. Spatial regression and neighborhood analyses for data on lattices.

List of Potential Advisers and Departments

Advisers come from many Virginia Tech departments and they must sign off on your desire to work toward the certificate. Most of these persons are in the College of Natural Resources and Environment, but there are many faculty who use GIS and remote sensing techniques in their research and they may advise you in appropriate courses for the certificate as part of their advising you in your research degree program.

For certificate aspirants who are non-degree students, Dr. Rijal will be your adviser. His expertise will be in picking the four courses that best suit your career interests in achieving the certificate.

Gerontology
GRTC

Address:
Center for Gerontology, Virginia Tech, 230 Grove Ln (MC 0555)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Center for Gerontology

Web Resource(s):
• Website

Phone Number(s):
• *Center for Gerontology:* 540/231-7657

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Graduate Certificate in Gerontology is a university-approved program of advanced study offered by the Center for Gerontology. The required minimum of 9 credits focus on three core gerontology competency domains, namely aging processes and outcomes related to (1) biological changes and health, (2) dimensions of psychological functioning, and (3) contemporary social and societal issues. The goal of the curriculum is to offer learning experiences consistent with the recommendations of the Association for Gerontology in Higher Education. The Center for Gerontology is designated a Collaborating Centre by the International Association for Gerontology and Geriatrics (IAGG), signifying that the Center meets IAGG criteria for excellence, including being a sustainable university-level research center, offering a gerontology training program, engaging in research resulting in peer-reviewed publications, and having multiple research affiliates.

How to Apply:
Fill out the online application for participation in the certificate program.

Gerontology
GRTC

Address:
Center for Gerontology, Virginia Tech, 230 Grove Ln (MC 0555)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Center for Gerontology

Web Resource(s):
• Website

Phone Number(s):
• *Center for Gerontology:* 540/231-7657

Admission Requirements

Applicants for the Graduate Certificate in Gerontology must complete the following requirements:

- Obtain admission to the Graduate School in a degree program or as a non-degree student: Apply here.
- Complete the Center for Gerontology application form.
- Complete the Graduate School Graduate Certificate Application form, get signature from the Director of the Center for Gerontology, submit form to the Graduate School, and submit a copy to the Center for Gerontology.
- International students must be able to read, write, and speak English.

Course Requirements

The Graduate Certificate in Gerontology requires 9 credits:

Module #1 – Foundations of Gerontology
• HD 5104 Adult Development & Aging I

Module #2 – Biology/Health
• PHS 5714 Health of the Elderly

Module #3 – Gerontology Elective (3 cr)
• HD 5114 Adult Development & Aging II
• SOC 5714 Aging in Social Context
• 5904 Project and Report
• 5964 Practicum/Field Study
• Other approved course; assignments will be focused on gerontology

Optional Practicum/Field Study

An optional practicum or field study may be arranged through the student's academic department or the Center for Gerontology. The contract or letter of agreement with the host agency is reviewed and signed by the Center's director, the student, an agency representative, and the faculty supervisor before the experience occurs in order for credit to be granted. A copy of the final written report on the internship or field study must be submitted to the Center for Gerontology for the student's file. See Practicum Guidelines for more details.

Thesis/Dissertation Requirement

The research topic of the thesis or dissertation must be on an issue in adult development and aging. This requirement is not meant to supersede the authority of the student's committee. Its aim is to assure that an issue in gerontology is examined in the research. To meet this requirement:

Meet with the center director to discuss the topic of the thesis/dissertation before completing the proposal.

After the advisory committee has approved the final draft of the thesis/dissertation, submit a signed cover sheet and abstract to the Center for Gerontology.

Final Documentation

Submit the Graduate School's on-line Application for Certificate Conferral Form by the Application for Degree deadline. Students applying for a degree and the Certificate conferral in the same semester/summer session will pay only one fee if the forms are submitted at the same time.

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Global Planning and International Development Studies GPID

Address:
201 Architecture Annex
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Ralph Hall

Web Resource(s):

Phone Number(s):

Certificate Overview

The world is facing enormous challenges in the next century including climate change, water scarcity, world hunger, poverty, rapid urbanization, unemployment, natural habitat loss, resource degradation, and fiscal and institutional mismanagement. To face these challenges, we need thoughtful, ethically informed, and future-oriented solution builders who are thinking at a global scale.

The Graduate Certificate in Global Planning and International Development Studies builds on Virginia Tech's internationally recognized, 50-year specialization in international development planning and an innovative partnership between faculty in programs such as Urban Affairs and Planning, Public Health, Geography, and Building Construction. The certificate seeks to prepare graduate students in multiple disciplines to engage in meaningful global professional leadership and academic positions to systematically tackle and resolve these global planning and development issues.

The certificate may be taken in conjunction with most of Virginia Tech's masters and doctoral degree programs.

How to Apply:
Fill out the online application for participation in the certificate program.

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Global Planning and International Development Studies
GPID

Address:
201 Architecture Annex
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Ralph Hall

Web Resource(s):

Phone Number(s):

Admission Requirements

The certificate is open to all graduate students pursuing masters or doctoral degrees at Virginia Tech. Interested non-degree students may be considered for admission on a case-by-case basis. Prospective certificate applicants should confer with their respective graduate degree program academic advisors to ensure that pursuit of the certificate will productively complement their primary graduate degree objectives.

Course Requirements

The core of this graduate certificate focuses on global planning issues and development project design, implementation, and evaluation.

Following the required two-course, six-credit core sequence, students may select an additional six credit hours in three specializations:

- Non-profit and Non-governmental Organization Management and Development
- Sustainable Infrastructure Development
- Public and Environmental Health and Global Development

Additional graduate courses of study in environmental planning and policy, women and gender in international development, natural resources management, homeland and global security, agricultural and rural development, and international business management are also offered at Virginia Tech and may be taken in addition to the three areas of specialization.

Required Core Courses (6 to 9 credit hours)

1. UAP 5764G International Development Policy and Planning (3H) or equivalent course (e.g., GIA 5524: International Development) if approved
2. UAP 5764 International Development Planning Studio (3H)

Elective Courses (6 credit hours)

Non-profit and Nongovernmental Organization Management and Development

- UAP 5364 Nongovernmental Organizations in International Development
- UAP 5454 Nonprofit Organization and Management
- UAP 5534 Nonprofit Leadership and Governance
- UAP 5544 Public and Nonprofit Financial Management

Sustainable Infrastructure Development

- UAP 5324 Topics in Infrastructure Planning in Developing Countries
- UAP 5864 Topics in Transportation Policy and Planning
- BC 5144 Sustainable Infrastructure Systems

- UAP 5424 Urban Planning in Europe (1 H)

Public and Environmental Health and Global Development

- PHS 5004 Fundamentals of Public Health
- PHS 5014 Environmental Health
- PHS 5224 Comparative Health Systems
- GEOG 5214 Health and the Global Environment

[Note: The two required elective courses can be selected from two different areas of specialization.]

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Global Sustainability
GSC

Address:
Virginia Tech Research Center, 900 North Glebe Road
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• GCGS Information

Web Resource(s):
• Graduate Certificate in Global Sustainability

Phone Number(s):
• *Center for Leadership in Global Sustainability:* 571/858-3338

Certificate Overview | Admissions & Course Requirements

GCGS Overview

This 9 credit hour graduate certificate is designed for professionals seeking training and experience in international sustainable development, with a particular emphasis on environmental sustainability in emerging economies. **Graduate Certificate in Global Sustainability (GCGS)** is ideal for students from all professions and disciplines, and from around the world. All courses are offered online, so you can study at your own pace.

For more information, click here to access our website.

How to Apply:
Fill out the online application for participation in the certificate program.

Global Sustainability GSC

Address:
Virginia Tech Research Center, 900 North Glebe Road
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• GCGS Information

Web Resource(s):
• Graduate Certificate in Global Sustainability

Phone Number(s):
• *Center for Leadership in Global Sustainability:* 571/858-3338

Certificate Overview | Admissions & Course Requirements

GCGS Admission Requirements

Students can apply for the Graduate Certificate in Global Sustainability (GCGS) as a degree-seeking student or non-degree Commonwealth Campus student at Virginia Tech, or as a visiting student from another institution. If you are not currently enrolled as a graduate student, you must apply for graduate admission through the Virginia Tech Graduate School as a Graduate Certificate status applicant. Requirements for admission include:

- Completed undergraduate degree
- 2-3 Letters of Recommendation
- Current resume/ CV
- Personal goal statement
- Completed application
- No GRE required; TOEFL may be required for international students

Course Requirements & Global Study location

The GCGS can be completed in a single academic term or over the course of several semesters. All NR courses are offered 100% online.

Required coursework:

- NR 5114 Global Issues in Environmental Sustainability** - 3 hours
- NR Elective - 3 hours
- NR Elective - 3 hours

** As part of our mission to build leadership for global sustainability, the required NR 5114 Global Issues in ES course includes a 10-day in-person, team-based study abroad experience. Additional costs include the program fee + round-trip airfare. Locations include:

- Argentina
- Finland
- Iceland
- Ireland
- Italy
- South Africa
- Spain

Given the dynamic nature of travel at the moment, we are following Virginia Tech's travel and study abroad policies to inform our decisions on destinations and timing.

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Health Information Technology
HITC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Health Information Technology

The healthcare industry is ever evolving. With the adoption of electronic medical records, telemedicine, and the International Classification of Diseases Tenth Edition (ICD-10) migration, there is demand for those with skills in both information technology and the healthcare field. The certificate in Health Information Technology aims to provide competence in patient informatics and the use of evidence based medicine, electronic prescribing, and telemedicine as tools to improve patient health and medical systems operation through grounding in health record organization from the multiple perspectives of patients, technicians, nurses, hospital administration, and insurance companies. Students will understand the use of business intelligence and analytics in data rich organizations and obtain the ability to develop and apply business intelligence and analytics solutions to various types of decision problems.

How to Apply:
Fill out the online application for participation in the certificate program.

Health Information Technology
HITC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Admissions Requirements for the Graduate Certificate in Health Information Technology

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
    - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
    - Earn a minimum IELTS score of 6.5.
    - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Health Information Technology

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

ACIS 5504 – Information Systems Design & Database Concepts: This course is an introduction to design methodologies in information systems. Structured systems analysis and design methodologies are discussed. An introduction to database design methodologies is also included. Topics related to different database models and their implementation is discussed. Students are also required to design and implement information systems using appropriate computer software.

BIT 5564 – Healthcare Information Technology: Use of information technology in the healthcare industry. Topics address electronic health records, patient informatics, evidence based medicine, electronic prescribing and telemedicine. The use of these technologies to improve patient health and medical systems operations.

BIT 5574 – Healthcare Data Management: Organization and management of data in the healthcare industry. Includes standards for electronic health records, healthcare enterprise systems architecture, health database design, existing database platforms, data integration from multiple sources, database accessibility. Analysis of healthcare-related organizations from the perspective of multiple user groups including patients, technicians, nurses, physicians, clinics, hospitals and insurance companies.

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Higher Education Administration
HEAC

Address:
1750 Kraft Dr.
Blacksburg, VA 24060

Contact this Certificate

Email Contact(s):
• Claire Robbins

Web Resource(s):
• Website

Phone Number(s):
• *Office Phone::*
540/231-2004

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The graduate certificate program in Higher Education Administration targets full-time college administrators who may not have studied higher education through any formal degree program but wish to develop a deeper understanding of the environment in which they work. Doctoral students engaged in other disciplines who plan to enter the academy as faculty members may also benefit from this certificate program.

How to Apply:
Fill out the online application for participation in the certificate program.

Higher Education Administration
HEAC

Address:
1750 Kraft Dr.
Blacksburg, VA 24060

Contact this Certificate

Email Contact(s):
• Claire Robbins

Web Resource(s):
• Website

Phone Number(s):
• *Office Phone::*
540/231-2004

Admission Requirements

Those who wish to seek the certificate need to be admitted to a graduate degree program (https://ess.graduateschool.vt.edu/pages/login.php), or admitted as a non-degree seeking or a Commonwealth Campus student (https://applyto.graduateschool.vt.edu/apply/). In addition to the appropriate admission application, students must complete the Application for a Graduate Certificate. The Graduate School requires a GPA of 3.0 for admission to Certificate Status and official transcripts must be submitted.

Students already enrolled in a graduate degree program at Virginia Tech should submit the Application for a Graduate Certificate. Note that students pursuing a degree and a certificate simultaneously are classified in their degree program. Six of the credits used toward a certificate may be used in meeting degree requirements if they are appropriate for inclusion on the Plan of Study for the degree.

Enrollment may be limited based on class size. Certificates will be awarded upon the student's application for the certificate once they have successfully completed the course requirements and submitted the Application for Conferral of Degree or Certificate form.

Course Requirements

The certificate requires successful completion of a total of 12 credit hours, of which 6 credits are required courses and 6 credits are elective. Students need to receive a grade of B or better in each course to receive the certificate. Students receiving a grade below a B will have to re-take the course before credit will be awarded. All courses are 3 credit hours and are offered annually or every other year, depending upon availability of the faculty.

All students must complete:

EDHE 6064 – Higher Education in the United States
EDHE 6274 – Higher Education Law

In addition, students are encouraged to complete one of the following three tracks or propose two courses to create their own track. (For more information about these tracks, please contact the certificate program leader, Claire Robbins.)

Student Development and Learning Track

EDHE 5314 – Theories of Student Development (offered each fall)
EDHE 5334 – The College Student and the College Environment (offered each spring)

Governance and Policy Track

EDHE 6084 – Financial Administration in Higher Education (historically offered every other spring; most recently offered spring 2022)
EDHE 6044 – Governance and Policy in Education (historically offered every other spring; next offered spring 2023)

Organizations and Management Track

EDHE 6304 – Theories of Educational Organizations (historically offered every other fall; next offered fall 2023)
EDHE 6094 – University Leadership (historically offered every other fall; most recently offered fall 2022)

Eligibility

Those enrolled as graduate degree-seeking or Commonwealth Campus (non-degree-seeking) students are eligible to receive a Certificate in Higher Education Administration.

For more information, please contact Dr. Claire Robbins at robbinsc@vt.edu.

To access Virginia Tech's Equal Opportunity/Affirmative Action statement, please visit this page.

Location

Faculty members in the Higher Education program hold offices on the second floor of the building located at 1750 Kraft Drive, Blacksburg, Virginia 24060. This building is situated in the Corporate Research Center, opposite the airport and just off Research Center Drive.

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Homeland Security Policy Certificate
HSC

Address:
School of Public and International Affairs 900 N. Glebe Rd
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• Patrick Roberts
• Jeff Glick

Web Resource(s):
• CPAP Website
• Certificate Website

Phone Number(s):
• *Colleen Malley:*
540/231-5133
• *Kelly Crist:*
540/231-5133

Certificate Overview

The graduate certificate in homeland security focuses on U.S. domestic security and emergency management issues. The certificate serves either as a stand-alone credential of advanced educational achievement for non-degree students or as a supplement to a master's or doctoral degree. Four homeland security courses will introduce students to the complexity of the homeland security environment, from analyzing the terrorist threat, to considering questions of hazard mitigation, preparedness, and resilience, to investigating response and recovery strategies.

Taught by a mix of scholars and practitioners, the certificate addresses issues of homeland security strategy, policy design, planning, operations, managing across and among networks, and implementation.

The certificate is composed of four courses (12 hours of graduate coursework). The two core courses focus on 1) actions and conditions before an event (e.g. prevention) (PAPA 6264), and 2) response and recovery after an event (PAPA 5354). The third and fourth courses are selected from specified electives.

The certificate is open to non-degree students as well as degree seeking graduate students across Virginia Tech. MPA students may use the certificate as their concentration and reflect upon the certificate and homeland security issues in their portfolio or internship. Ph.D. students may use the certificate as a foundation for dissertation research in homeland security policy and management. Transfer credits are not permitted.

How to Apply:
Fill out the online application for participation in the certificate program.

Homeland Security Policy Certificate
HSC

Address:
School of Public and International Affairs 900 N. Glebe Rd
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• Patrick Roberts
• Jeff Glick

Web Resource(s):
• CPAP Website
• Certificate Website

Phone Number(s):
• *Colleen Malley:*
540/231-5133
• *Kelly Crist:*
540/231-5133

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Non-degree candidates may apply for admission to the certificate program using the Virginia Tech Graduate School's online application system found at Admissions. Interested students must submit an official copy of their college transcript documenting receipt of a bachelor's degree from a regionally accredited college or university with an acceptable grade point average mailed to the Virginia Tech Graduate School as part of the application process. Current graduate students also may pursue the certificate.

Course Requirements

Students must take four courses (12 hours), including two required classes to receive the certificate.

Required

- PAPA 6264 Advanced Topics in Policy Systems Management
  *or when the topic is focused on homeland security.
- PAPA 5354 Homeland Security Response and Recovery

Electives (choose two):

- PAPA 5254 Homeland Security and the Terrorist Threat
- SPIA 5124: Decision Making, Reflective Practice, and Engagement in STEM-H Domains
- UAP 5214: Topics in Natural Resources Hazard Planning
- PAPA 5974: Independent Study
- PAPA 6254: Advanced Topics in Public Policy
- PAPA 6214: Public Policy Processes and Analytic Approaches (3 credits)
- PAPA 6254 Advanced Topics in Homeland Security Policy: Critical Infrastructure Protection and Resiliency
- GIA 5514/PSCI: Global Security
- PAPA 5974 Independent Study
- PAPA 5904 Project and Report
- PAPA/STS 6664 Advanced Topics in Science and Technology: Complexity, Emerging Policy,

Doctrine, and Reality

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Hospitality and Tourism Analytics and Revenue Management
HTAC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Professor Mahmood Khan

Web Resource(s):
• Website

Phone Number(s):
• *Mahmood Khan:* 703/538-8486

Certificate Overview | Admissions & Course Requirements

Hospitality and Tourism Analytics and Revenue Management Certificate Overview

This graduate certificate will provide middle managers in the Hospitality and Tourism industry with the tools and skills required to engage in high-level strategic thinking and analysis in the areas of revenue management and business analytics. Specifically, this certificate will provide methods to utilize information systems as tools for dynamic forecasting of supply and demand and maximize profits in HTM-related businesses. Skills gained will ultimately allow certificate holders to compete for upper level managerial positions.

Upon completion, students will be able to:

- Determine the strategic roles of information systems in today’s hospitality/tourism organizations.
- Implement information technology applications.
- Apply the components of Web marketing and distribution practices.
- Compare and contrast information systems that support business intelligence and data analytics in hospitality/tourism.
- Evaluate emerging data analytics tools in operations and strategic decision making.
- Analyze effectiveness and return on investment of information systems.
- Evaluate revenue management (RM) as a dynamic strategic process.
- Create and implement an effective RM process.
- Implement RM within the framework of Customer Relationship Management.
- Analyze the key elements of dynamic forecasting of demand, supply, cancellations and no-shows.
- Apply the key elements of setting RM controls and rate fences / restrictions.
- Analyze positioning, segmentation, target market selection, product development, pricing and channel management within the context of RM policies and processes.

- Manage the interface between revenue management with human resources and information systems management in hospitality service environments.

- Articulate and debate the ethical aspects of revenue management in hospitality services environments.

How to Apply:
Fill out the online application for participation in the certificate program.

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Hospitality and Tourism Analytics and Revenue Management HTAC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Professor Mahmood Khan

Web Resource(s):
• Website

Phone Number(s):
• *Mahmood Khan:* 703/538-8486

Hospitality and Tourism Analytics and Revenue Management Admission Requirements

Number of Credit Hours:

Graduate certificates can be awarded to individuals who do not desire to work toward a degree as well as to students who are working on graduate degrees. Interested students must submit an official copy of their college transcript or diploma documenting receipt of a bachelor's degree from a regionally accredited college or university with an acceptable grade point average mailed to the Virginia Tech Graduate School as part of the application process. Please contact us for specific instructions on applying online. Students should meet with the MSBA-HTM and Graduate Certificates Advisor and submit the application form to the HTM Graduate Administrator for Certificate Program Approval signature no less than six months prior to completion of coursework.

Hospitality and Tourism Analytics and Revenue Management Course Requirements

9 credit hours. Transfer credits are not permitted.

Required Courses:

HTM 5564 Information Technology and Business Analytics in Hospitality and Tourism. Study of the most widely used information systems in operation, management, and e-business in hospitality and tourism. Study of emerging data analytics tools for business intelligence and strategic decision making. Study of impacts of IT on organizations and the industry overall. (3C)

HTM 5574 Revenue Management for Hospitality Services. Dynamic forecasting of supply and demand, customer relationship management, services production, pricing, promotion, and distribution. Implications for human resources and information systems management. Application and integration of revenue and customer centric management theory. (3C)

Restricted Elective Courses:

Choose one of the following:

MGT 5804 Strategic Leadership in Technology-based Organizations (online). This course focuses on the role of the leader in crafting corporate and business strategies where technology provides the basis for the firm's competitive advantage. It helps students understand the root causes of common problems in innovation, showing how these can manifest themselves symptomatically in various stages of the development process, and in different areas of the company. The aspiration of this course is first to help managers build the tools to understand the real, underlying reasons why efforts to innovate so often fall short of expectations - and then with that understanding as a foundation, to learn how to build action plans that resolve the root problems. (3C)

BIT 5594 Web Applications and E-Commerce (online). An examination of the concepts, technologies, and applications of electronic commerce. Topics include the World Wide Web as a platform for electronic commerce; intranets; electronic data interchange; electronic banking and payment systems; security and firewalls; software agents; and the social, legal, and international issues of electronic commerce. (3C)

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Human Centered Design
HCDC

Address:
Institute for Creativity, Arts, and Technology 190 Alumni Mall
Blacksburg, Virginia 24061

Contact this Certificate

Email Contact(s):
• Ivica Ico Bukvic
• Scott McCrickard

Web Resource(s):
• HCD Website
• ICAT Website
• C+I Website

Phone Number(s):
• *Ivica Ico Bukvic:* 540/231-6139
• *Scott McCrickard:* 540/231-6698

Human-Centered Design Overview

An introduction to human-centered design benefits your graduate research and broadens your career prospects. Whether studying to be a designer, engineer, scientist or artist, your work ultimately impacts real people and the world around us. Taking users seriously improves how projects are conceived and executed.

DESIGN MATTERS

The act of creating something new shows up in many human endeavors. It can be a solution to a mundane problem like holding sheets of paper together or something as complex as the formulation of new institutions. Human Centered Design (HCD) is focused on opportunity- and problem-finding, and problem-solving, and is charged with understanding the needs, wants, and limitations of end-users. This is accomplished through methodologies and practices where these considerations are integrated at every stage of the design process.

HCD creates novel learning and discovery opportunities that are needed to train the future professoriate, workforce, professionals and civic leaders. HCD can only be taught in a true interdisciplinary educational environment in which coursework and research embrace diversity, inclusiveness, educational breadth, and interdependence, while promoting a person- and world-oriented, rather than a product-oriented, attitude towards education.

INTERDISCIPLINARITY MATTERS

Recent trends show that both higher education institutions and government agencies seek employees with interdisciplinary backgrounds, demonstrating strengths in more than one field, and the agility to work with colleagues across fields. To address this, our Interdisciplinary Graduate Education Program (IGEP) provides opportunities for graduate students whose goals cannot be met by a single discipline from a degree granting academic unit at the university.

“Real world problems don’t fit nicely into boxes, specific fields, departments or programs,” said Professor of Civil and Environmental Engineering Amy Pruden, who managed the program from 2015-17. “We need to have the opportunity for students so inclined to tackle these problems.”

In the Certificate program, students learn the core ideas of HCD, explore how it applies in their own professional domains, and discover how their own research connects with projects in other disciplines. In particular, it leverages interdisciplinarity to see how to learn from the world around. The ability to collaborate across disciplines is a high-demand skill set in the private and public sectors and higher education careers, because institutions recognize that creative solutions to the most important societal challenges requires integrating aesthetics, analysis, and technological development.

HCD is a part of Virginia Tech's Creativity + Innovation (C+I) transdisciplinary initiative and the Institute for Creativity, Arts, and Technology (ICAT).

For additional info visit the HCD website.

How to Apply:
Fill out the online application for participation in the certificate program.

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Human Centered Design
HCDC

Address:
Institute for Creativity, Arts, and Technology 190 Alumni Mall
Blacksburg, Virginia 24061

Contact this Certificate

Email Contact(s):
• Ivica Ico Bukvic
• Scott McCrickard

Web Resource(s):
• HCD Website
• ICAT Website
• C+I Website

Phone Number(s):
• *Ivica Ico Bukvic:* 540/231-6139
• *Scott McCrickard:* 540/231-6698

Certificate Overview | Admissions & Course Requirements

HCD Certificate Admission Requirements

Any student who has gained admission to a graduate program at Virginia Tech is eligible to take part in the Human-Centered Design (HCD) Certificate program. Other than filling out the appropriate certificate forms provided by the Graduate School, there are no additional admission requirements associated with the HCD Certificate.

HCD Course Requirements

The graduate certificate requires completion of 12 credit hours, with 6 credits prescribed, and 6 credits selected from two of three areas. Take both courses from the 'Required' section below, then choose at least 1 more course from any two of the areas 1, 2, and 3 for a total of 12 credits. (The elective courses should be in different areas.) Given that some of the courses are offered sporadically, potential substitutions are possible, where appropriate. If you have questions, please contact Ivica Ico Bukvic and Scott McCrickard, co-directors.

***Required:* INTERDISCIPLINARY RESEARCH**

- GRAD 5134: Topics in Interdisciplinary Research (when HCD topic is offered)
- CS 5724: Models and Theories of Human-Computer Interaction

***1.* DESIGN STUDIES**

- ART 5524: Topics in Human Centered Design (studio)
- ENGE 5024: Design in Engineering Education and Practice
- STS 6614: Adv. TS: (Cultures of Design; Origins of Innovation)

***2.* UNDERSTANDING PEOPLE**

- CS/ISE 5714: Usability Engineering
- CS 5734: Computer-Supported Collaborative Work
- EDIT 5234: Intro to the Learning Sciences
- ENGE 5404: Assessment Techniques in Engineering Education
- ISE 5604: Human Information Processing I
- ISE 6604: Human Factors in Visual Display Systems
- ISE 6094: Cognitive Task and Work Analysis

- PSYCH 5354: Information Processing
- STS 6244: TS: History, Culture, and Politics of the Internet

***3.* DESIGN REALIZATION**

- ART 5714: TS: Creative Code for Art & Design; TS: Interaction Design
- CS 5764: Information Visualization
- CS 5774: User Interface Software
- CS 6724: Advanced Topics In Human Computer Interaction
- ECE 5564: Wearable + Ubiquitous Computing
- EDIT 5624: Interactive Learning Media, Arts, and Design
- EDIT 5614: Digitally Mediated Learning
- EDIT 5624: Interactive Learning Media, Arts, and Design
- EDIT 5634: Interactive Learning Media Development
- ENGL 5074: Introduction to Digital Humanities
- ENGL 6344: Rhetoric in Digital Environments
- ISE 6604: Human Factors in Visual Display Systems
- ISE 6614: Human Computer Systems
- ME 5644: Rapid Prototyping

Human-Centered Design and Human-Computer Interaction certificate programs

For graduate students interested in the design of interactive systems, there are two graduate certificates: the Human-Centered Design certificate and the Human-Computer Interaction certificate.

- The **HCD certificate program** focuses on creating the "new" – that is, design. It does so through the application of a "human-centered" paradigm; some key human-centered methodologies are participatory design and user experience design. Designing this way can be applied in many areas from consumer products to computer interfaces.
- The **HCI certificate program**, in contrast, does not emphasize (or even require) design. It focuses specifically on computer and information system interfaces. There are many ways of knowing what constitutes a "good" interface and the certificate program approaches the question using research, evaluation and design ways of knowing.

Thus, the two certificate programs complement one another. It is possible to attain both certificates with careful planning of additional course work and selection of thesis or dissertation topics. Courses may be counted towards no more than two credentials (certificates and degrees).

2013-2015 course list

The following is the previous course list. It is provided for those students who have already begun the HCD Certificate program:

The graduate certificate requires completion of 12 credit hours, with 6 credits prescribed, and 6 credits selected from across two of three areas. Take both courses from the 'Required' section below, then choose 2 more courses from area 1, 2, or 3 for a total of 12 credits.

REQUIRED

GRAD 5134: Topics in Interdisciplinary Research (3 credits- when HCD topic is offered)

ART 5524 (ART 5984 Fall 2014): Topics in Human Centered Design (3 Credits, Fall only)

Area 1: Creative Problem Solving

ART 5714: TS: Creative Code for Art & Design; TS: Interaction Design

EDIT 5624: Interactive Learning Media, Arts, and Design

ENGE 5024: Design in Engineering Education and Practice

ME 5644: Rapid Prototyping

Area 2: Computational Practices

CS/ISE 5714: Usability Engineering

CS 5724: Models and Theories of HCI

CS 5764: Information Visualization

CS 5774: User Interface Software

CS 6724: Advanced Topics In Human Computer Interaction

ECE 5564: Wearable + Ubiquitous Computing

EDIT 5624: Interactive Learning Media, Arts, and Design E

EDIT 5634: Interactive Learning Media Development

ISE 5604: Human Information Processing I

ISE 6614: Human Computer Systems

ISE 6604: Human Factors in Visual Display Systems

Area 3: Interdisciplinary Research

EDIT 5234: Intro to the Learning Sciences

EDIT 5614: Digitally Mediated Learning

ENGE 5404: Assessment Techniques in Engineering Education

ENGL 5074: Introduction to Digital Humanities

ENGL 6344: Rhetoric in Digital Environments

STS 6244: TS: History, Culture, and Politics of the Internet

STS 6614: Adv. TS: (Cultures of Design; Origins of Innovation)

Human Factors of Transportation Safety
HFTC

Address:
3500 Transportation Research Plaza (0536)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Miguel Perez, Ph.D., CPE, Program Coordinator

Web Resource(s):
• Human Factors of Transportation Safety Graduate Certificate Program

Phone Number(s):
• *Miguel Perez, Ph.D., CPE, Program Coordinator:* 540/231-1537

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Human Factors of Transportation Safety Graduate Certificate Program (HFTS GCP) focuses on the driver characteristics, states, behaviors, and performance factors that, in interaction with vehicle, traffic, and roadway factors, have a major influence not only on mitigating the deleterious effects of crashes, but on actively avoiding them altogether. Virginia Tech is uniquely positioned to offer such a program by integrating the strengths of the Virginia Tech Transportation Institute (VTTI) in partnership with the following academic departments, as all of these are already focusing on integrating human factors into their curricula and research programs:

- Biomedical Engineering and Mechanics
- Civil and Environmental Engineering
- Industrial & Systems Engineering
- Psychology
- Statistics

The HFTS Graduate Certificate Program is housed and administered within VTTI (with support from the Graduate School and affiliated faculty of the partnering departments). It is important to note that the Certificate must be pursued as an integral part of the student's Master's or Doctoral matriculation plan at Virginia Tech; it may not be pursued independently.

Mission Statement: *Create and deliver in-depth knowledge and marketable skills applied to the research, evaluation, maintenance, improvement, and protection of all transportation users and their communities via the application of human factors theories, tools, and methods; and to train the next generation of leaders in the field of the human factors of transportation safety within the Commonwealth and across the Nation.*

For many years, Virginia Tech has been offering a number of undergraduate and graduate courses with relevance to the human factors issues associated with transportation safety. Offering the HFTS GCP as an option to graduate students at Virginia Tech appropriately emphasizes the ever-increasing importance of this field and focuses student learning and skills acquisition on a comprehensive domain of knowledge and skills. The HFTS Certificate provides students the requisite advanced skills and expertise necessary to join the transportation safety field in industry as well as research communities. The integration and expansion of human factors-related transportation safety offerings at Virginia Tech will continue to contribute effectively to the enhancement of transportation safety state-wide, nationally, and internationally.

Course Requirements Overview

▪ Four courses must be selected from a structured menu of options (see Course Requirements section for details).

▪ Courses from at least 3 of the 5 affiliated departments noted above must be represented in the student's *overall graduate program of study*.

How to Apply:
Fill out the online application for participation in the certificate program.

Human Factors of Transportation Safety
HFTC

Address:
3500 Transportation Research Plaza (0536)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Miguel Perez, Ph.D., CPE, Program Coordinator

Web Resource(s):
• Human Factors of Transportation Safety Graduate Certificate Program

Phone Number(s):
• *Miguel Perez, Ph.D., CPE, Program Coordinator:* 540/231-1537

Admission Requirements

- Admission to the Graduate School
- Completing a Graduate Certificate Application is required for all students.
- Courses applied towards certificate credit must be part of an approved program of study.

Course Requirements

The certificate requires a total of 4 courses distributed as follows:

One course from *each* of Categories A, B, and C, and one course from *either* Category D or E

Category A: Transportation Safety / Risk Core

- **BMES 5234** Advanced Vehicle Safety Systems

- **CEE 5640** Highway Transportation Safety

Category B: Human Factors Core

- **ISE 5604** Human Information Processing

- **ISE 5605** Human Factors Systems Design I

- **PSYC 5344** Cognitive Psychology

Category C: Statistics and Research Design

- **ISE 5615** Human Factors Research Design

- **PSYC 5315** Research Methods

- **STAT 5374** Statistical Epidemiology and Observational Studies

- **STAT 5615/5616** - Statistics in Research

Category D: Transportation-Related Eng./ Modeling / Design

- **BMES 5164** Advanced Impact Biomechanics

- **BMES 5174** Biomechanics of Crash Injury Prevention

- **BMES 6164** Computational Modeling in Impact Biomechanics

- **BMES 6174** Advanced Human Modeling: Injury and Tissue Biomechanics

- **CEE 5604** Traffic Characteristics and Flow

- **CEE 5644** Transportation Systems Planning

- **CEE 5654** Advanced Geometric Design & Highway Safety

Category E: Human Factors Aspects of Transportation

- **CS/ISE 5714** Usability Engineering

- **ISE 5644** Human Audition and Auditory Display Design

- **ISE 6604** Human Factors in Visual Display Systems

- **ISE 6614** Human Computer Systems

- **ISE 6624** Advanced Topics in Human Factors [1]

- **PSYC 5404** Biological Bases of Behavior

- **PSYC 6404** Behavior Management in Large-scale Systems

- **STAT 5204** Experimental Design and Analysis I

- **STAT 5204G** Experimental Design: Concepts and Applications

- **STAT 5214G** Advanced Methods of Regression Analysis

- **STAT 5514** Regression Analysis

Thesis/Dissertation Topic & Optional Research Internship

- Thesis/Dissertation topic must be transportation safety related (and approved by the Human Factors of Transportation Safety Graduate Certificate Program administrative body as well as the student's graduate committee)
- If the student chooses the project option, it must be transportation safety related, ***and*** the student must take an additional course (5 total courses), with the fifth course being selected from any category within the HFTS GCP menu, A-E.
- Optional research internship for one semester up to one year at VTTI or equivalent opportunity (e.g., NHTSA, GM, etc. [can earn up to 6 research credit hours and up to 3 independent study credit hours per semester of internship]) – note that these optional hours/experiences do not substitute for any of the 12 required credit hours.
- Prior to filling in the Graduate School's Certificate Application Form, the prospective student should first contact the HFTS Program Coordinator.

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Human Sexuality Studies
HSSC

Address:
315 Wallace Hall, 295 West Campus Dr.
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Rose Wesche

Web Resource(s):

Phone Number(s):

Certificate Overview

The VT Graduate Certificate in Human Sexuality Studies program draws on diverse and interdisciplinary perspectives to produce insights into how sexual expression, behavior, and representation are shaped by multiple intersecting individual and cultural contexts, and how they, in turn, shape the health and well-being of individuals, communities, and populations.

Graduate students engage in research and take three core courses (9 credits) covering sexuality from life-course/development perspectives, feminist/queer theory perspectives, and public health/human rights perspectives. While both broadening and deepening student knowledge about the psychological, familial, social, cultural, and political aspects of human sexual behavior and health from a global perspective, this program encourages intercultural understanding, problem-solving, and social responsibility.

Core Courses:

HD 5344 Perspectives on Human Sexuality

PHS/HD/WGS 5244 Sexual Health and Human Rights

WGS 5934 Sexualities and Queer Theory

How to Apply:
Fill out the online application for participation in the certificate program.

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Human Sexuality Studies
HSSC

Address:
315 Wallace Hall, 295 West Campus Dr.
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Rose Wesche

Web Resource(s):

Phone Number(s):

Admissions Requirements

Graduate students who have already been accepted into any graduate program or graduate studies at Virginia Tech can apply to the certificate program. To apply, please complete the following materials and contact the program Director:

1. A **Letter of Interest** (250–500 words: include your past work experience, your long-range education and career objectives, and your reasons for applying to the Certificate)

2. A copy of your most recent **Curriculum Vitae** (CV/resume)

3. A VT **Graduate Certificate Application form** (available at: https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Application_for_Graduate_Certificate_Program.pdf)

For more information, please contact Dr. Christine Kaestle, the Human Sexuality Studies Program Director, at kaestle@vt.edu.

Curriculum Requirements

The graduate student's research agenda must relate to human sexuality, as approved by the program director. Students are required to take three core courses:

HD 5344 Perspectives on Human Sexuality (3 cr). Interdisciplinary historical consideration of writings, research, theory, and application of knowledge related to human sexuality from developmental and family studies perspectives.

PHS/HD/WGS 5244 Sexual Health and Human Rights (3 cr). Sexual and reproductive health from human development, public health, and critical feminist perspectives, with special attention to human rights issues. Sexually transmitted infections; HIV/AIDS; unintended pregnancy; population policies; eugenics; sexual and reproductive rights; positive sexuality, sex education; and health promotion.

WGS 5934 Sexualities and Queer Theory (3 cr). Theoretical perspectives of queer studies and its influence on sexuality studies. Historical and cultural constructs of sexuality and gender. Queer epistemologies that implicate traditional notions of technology, identity, desire, normativity, and social control. Intersections of gender, race, sexuality, ethnicity, class, age, transnational borders, and (dis) ability.

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Human-Computer Interactions HCIC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
- Dr. Scott McCrickard

Web Resource(s):
- Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

A Graduate Certificate in Human-Computer Interaction (HCI) Program is administered by the Center for Human-Computer Interaction and offered in conjunction with either a master's or doctoral degree in most departments. It gives graduate students the opportunity to develop their skills in HCI through courses and through their thesis or dissertation work.

How to Apply:
Fill out the online application for participation in the certificate program.

Human-Computer Interactions
HCIC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Scott McCrickard

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Any student who has gained admission to a graduate program at Virginia Tech is eligible to take part in the HCI Certificate program.

Course Requirements

Master's degree students complete 9 hours and doctoral students 15 hours of coursework for the certificate; at least two of the courses taken must be outside the student's degree program requirements and home department. These courses should be relevant to HCI; any exceptions to courses not on the web site must be cleared by the certificate coordinator. If the student writes a thesis or dissertation, it must be related to human-computer interaction. Students can normally fit the requirements for the certificate into their program of graduate study so that the time needed to complete the graduate degree in their basic discipline is not extended by simultaneously pursuing the certificate.

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Human-System Integration
HSIC

Address:
VT ISE Department 250 Durham Hall (0118) Blacksburg, VA 24061
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Hannah Parks

Web Resource(s):
• HSI Certificate

Phone Number(s):
• *Hannah Parks:*
540/231-5586

Certificate Overview | Admissions & Course Requirements

Human-System Integration

A four-course academic program that serves to expand and improve systems management and engineering practice, with emphasis on "human-technology interface" at various levels in the hierarchy and throughout the life cycle of complex technological and enterprise systems.

How to Apply:
Fill out the online application for participation in the certificate program.

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Human-System Integration
HSIC

Address:
VT ISE Department 250 Durham Hall (0118) Blacksburg, VA 24061
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Hannah Parks

Web Resource(s):
• HSI Certificate

Phone Number(s):
• *Hannah Parks:*
540/231-5586

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Bachelor's degree in science or engineering with undergraduate grade point average that meets VT Graduate School requirements for admission (other undergraduate degrees that included appropriate coursework in mathematics and statistics may also qualify).

Course Requirements

1. ISE 5804 Fundamentals of Systems Engineering [context for HSI]

2. ISE 5154 Technology Enabled Human Performance [critical component of HSI]

3. ISE 5144 Life Cycle Measurement of System Performance [value impact of HSI]

4. ISE 5434 Economic Evaluation of Applied Technology [value impact of HSI]

- All courses must have a grade of B or better.
- Transfer credits are not permitted.

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Inclusion and Diversity
IADC

Address:
Graduate Life Center, 155 Otey Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Shernita Lee

Web Resource(s):
• Diversity and Inclusion

Phone Number(s):
• *Director's Office:* 540/231-6529

Certificate Overview | Admissions & Course Requirements

Certificate Overview:

Description of Certificate:
The Graduate Certificate in Inclusion and Diversity extends graduate students' work in other disciplines by critically exploring the contemporary and historical foundations of diversity, equity, social justice, and inclusion within multiple fields. It explores biases, strategies for developing inclusive climates, fostering inclusion, and engagement to address diversity management, opportunities, and challenges. This certificate is for students seeking advanced skills, knowledge, and tools for effectively implementing formal and informal learning through pedagogy, programs, practices, and policies in a variety of settings. Students complete nine hours of coursework.
Target Audience:
This certificate program is open to all graduate students at Virginia Tech and external applicants who are seeking additional study in Inclusion and Diversity.

How to Apply:
Fill out the online application for participation in the certificate program.

Inclusion and Diversity
IADC

Address:
Graduate Life Center, 155 Otey Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Shernita Lee

Web Resource(s):
• Diversity and Inclusion

Phone Number(s):
• *Director's Office:*
540/231-6529

Admission Requirements:

Graduate students wishing to earn the graduate certificate in Inclusion and Diversity may be currently enrolled as masters or doctoral students in any discipline or major. Individuals must have satisfied all admissions requirements for their graduate degree and must remain in good academic standing. Graduate students submit the Graduate Certificate Application form to the Graduate School to formally enroll in the certificate program. Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study as determined by the student's faculty committee.

Individuals who wish to enroll at Virginia Tech to earn the Inclusion and Diversity graduate certificate without enrolling in a degree program may do so by submitting an online graduate certificate admission application. The Graduate School requires completion of a bachelor's degree from an accredited institution for admission.

When all certificate requirements have been satisfied, students must submit the Application for Degree or Certificate Conferral form to the Graduate School to authorize the issuing of the diploma and posting of the graduate certificate on the student's transcript.

Course Requirements:

Curriculum:
Graduate students must complete a minimum of nine graduate credits, six of which must be graded graduate credit with a grade of C- or better. Transfer credits are not permitted.

Required core course (3 credit hours):

- GRAD 5214 Diversity and Inclusion in a Global Society

Elective courses (6 credit hours) selected from an approved list of courses covering a range of inclusion and diversity topics. The two elective courses selected must be from two different groupings:

- Education - EDCO 5244, EDCI 5134, EDCI 5914, EDEL 5064, LS 5464, LS 5454
- Identity Development - HIST 5224, HIST 5934, HD 5344, HD 5424, PSCI5384/WGS 5424, WGS 5124, SOC 5624, SOC 5714, WGS 5914, WGS 6004, SOC 5984/ RLCL 5004, SOC 5614, SOC 5624
- Social -ENGL 5624, GIA 5274, SOC 5324, SOC 5414, SOC 5614, SOC 5034,UAP 5244, HD 5254, LS 5554, AFST 5364

Faculty:
The graduate certificate will be housed in the Graduate School and managed by the Dean for Graduate Education at Virginia Tech. All involved instructional faculty have doctoral degrees in related fields. The lead instructional faculty include:

Dr. Karen P. DePauw, Vice President and Dean for Graduate Education
Dr. Shernita Lee, Director of Recruitment, Diversity and Inclusion
Dr. Justin Grimes, Assistant Director of Recruitment, Diversity and Inclusion

Course Delivery Format:
Some courses are classroom-based, located on the Virginia Tech campuses in Blacksburg and the National Capital Region. Some courses are delivered via distance learning from Blacksburg to extended campus sites. Virginia Tech has advanced infrastructure and active support for online curricular delivery through Technology-enhanced Learning and Online Strategies (TLOS; http://tlos.vt.edu).

Resources:
Virginia Tech has the resources required to offer and sustain this certificate program. These include such resources as student support services (e.g., enrollment, help desk, library, etc.); faculty support services (e.g., copying, contracts, etc.); and general administration (e.g., budgeting and forecasting, facility maintenance, etc.).
Gainful Employment:
This certificate program will not come under gainful employment regulations.

Approved Elective Courses:

- EDCO 5244 *Counseling Diverse Populations* Examination and application of counseling strategies for special client populations including the exceptional; economically disadvantaged; culturally, racially and ethnically different; those with different life styles. Emphasis on the range of human characteristics. 3 credit hours

- EDCI 5134 *Gender and Education* Introduction to gender in the context of education. This course is intended to raise awareness of how gender is implicated in teaching and learning in K-12 schooling and higher education. School policy as it relates to gender equality and sex education. Theoretical frameworks for gender analysis in education. 3 credit hours
- EDCI 5914 *Diversity & Multicultural Educ in the Teaching of Engl Language Learners* Issues in diversity and multicultural education applied to teaching, PK-12 and adult English language learners. Reflections and articulation of personal cultural perspectives. Principles for developing classrooms that foster equity and access to academic success for all students. Integration of interdisciplinary planning and teaching of core content lessons for English language learners 3 credit hours
- EDEL 5064 *Contemporary Issues in Special Education* Current issues in special education confronting school personnel and the effect of the standards and accountability movement on students with disabilities and special education programs. Impact of diversity, including ability, cultural and environmental diversity, on education programming. Models, practices and services in spec ed. 3 credit hours
- ENGL 5624 *Intercultural Communication* Examination of theoretical and practical issues pertaining to writing and designing for intercultural and/or international audiences. 3 credit hours
- GIA 5274 *Comparative Social Movements* This course will investigate the forms of public protest that occur all over the world, with special attention to activism in poor nations and to the recent emergence of transnational movements. Also examines why and when governments repress social movements. Explores movements that are grounded in collective identities based in class, race/ethnicity, gender, religion, and culture 3 credit hours
- HIST 5224 *Readings in African History* Variable topics readings course focusing on historiographical trends on particular themes in African history. 3 credit hours
- HIST 5934 *Gender in U.S. History* Theoretical approaches to understanding the role of gender in political, economic and social life and in popular culture. Survey of major themes and developments since the seventeenth century. Concentration on the development of biological and sociological explanations of gender differences and similarities, and on the evolution of gendered politics and work and family relationships. Emphasis given to class, race, ethnic differences and differences in sexual orientation. 3 credit hours
- HD 5254 *Epidemiology and Health Inequities* Social determinants of health through the life-course. Relationship of social injustice to public health. Interplay of major social factors such as poverty, race and gender to influence health domestically and globally. Application of social epidemiology to a range of health outcomes. Inform effective solutions to health inequities. 3 credit hours
- HD 5344 *Perspectives on Human Sexuality* Interdisciplinary historical consideration of writings, research, theory, and application of knowledge related to human sexuality. 3 credit hours
- HD 5424 *Life Span Human Development* Stages of individual development as they occur in the context of the family life course. Overview of current developmental theories. Impact of race, gender, and class on cultural views of developmental norms. 3 credit hours
-
- LS 5464 *Leadership in a Global Society* Identification and definition of leadership in formal and non-formal education settings, communities, & organizations. 3 credit hours
- LS 5454 *Leadership in Diverse Contexts* Identification and development of the personal and professional competencies required for effective leadership in an increasingly global, diverse and multicultural society. 3 credit hours
- LS 5554 *Leading Social Change* Theories, processes and strategies employed to facilitate social and organizational change. Roles of change agents with respect to institutional structures, adaption, innovation, and the progression of change. Theoretical perspectives of managing change as applied to the systems and structures associated with society and how organizations operate within these systems and structures. Problem solving, social entrepreneurship, organizational change, and contemporary issues. 3 credit hours
- PSCI 5384/ WGS5424 *Identity Migration and Place* Place-based identities and intersectional inequalities. Influence of these interrelated dimensions on the study of forced and voluntary migrations within and across national borders, and such discourses as home, belonging, nationhood, and citizenship. 3 credit hours
- SOC 5034 *Social Inequality* Perspectives on the sources and consequences of social inequality. Comparative analyses of the dynamic social construction of differentiation based on such markers as class, race, ethnicity, gender, age, religion, and sexual orientation, and the opportunities and constraints for life chances afforded by these processes. 3 credit hours
- SOC 5324 *Theorizing the African Diaspora* African diaspora theories and their historical foundations.

Intersections of diaspora with race, gender, and national identities. Influence of theories of modernity, postcolonial studies, transnationalism, and globalization on contemporary debates about the African diaspora. Application of diaspora theories to different geographic sites in the African diaspora including Europe, the Americas, and Africa. 3 credit hours

- SOC 5414 *Crime, Control, and Social Inequality* Dimensions of crime and systems of social control within a framework of social inequality; examines issues of social inequality, such as discrimination, relative to race and ethnicity, social class, and gender, in crime and systems of social control; international scope. 3 credit hours
- SOC 5614 *Racial and Ethnic Health Disparities* Racial and ethnic health disparities in the United States. Contributions of social factors to inequality in medical care and health for minorities. Current and potential impacts of health care policies on health disparities. 3 credit hours
- SOC 5624 *Women and Work* The analysis of the economic activities of women in contemporary society. The past and present relationship between women's domestic and market labor is examined, followed by an in-depth investigation of women's labor force experiences. Competing sociological explanations are examined, providing the basis for exploring occupational segregation, inequalities of outcomes and comparable worth. 3 credit hours
- SOC 5714 *Aging in Social Context* Social, political, and economic environments of aging in a variety of cultures with emphasis on aging problems in American society. Evaluation of the major social theories of aging, their roles in defining problems of the elderly, and focusing on current social policy. 3 credit hours
-
- SOC 5984/ RLCL 5004 *Foundation Appalachian Studies* Interdisciplinary study of Appalachia. Historiographical debates and theoretical frameworks that inform contemporary scholarship in Appalachian studies, especially as they relate to race, class, gender, and place. Regional history and demographics. Cultural representations of Appalachia. Current social, economic, and environmental issues. Application of theoretical and historical considerations to the construction of research projects. 3 credit hours
- UAP 5244 *Multicultural* Examines the growing ethnic and demographic diversity of urban United States. Stresses theories and techniques that can be used to bring about more inclusive planning and public policies at all levels of government. 3 credit hours
- WGS 5124 *Gender, Bodies, and Technology* Intersections of gender, bodies, and technologies in multiple contexts and across disciplines. Technology in individual lives and the gendered discourses surrounding bodies and technologies. Feminist and queer theories of technoscience and the impact of technologies on gendered bodies. 3 credit hours

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Information Policy and Society
PIPC

Address:
Political Science (0130) Major Williams Hall, Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Website

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This graduate certificate program in Information, Policy and Society is designed for non-degree-seeking students and graduate students at Virginia Tech who wish to demonstrate special competence in the study of Information, Policy, and Society. This certificate responds to an existing demand by degree-seeking and non-degree students studying on campus or through on-line courses. As digital technologies interact and become more deeply embedded within society, federal and state agencies as well as businesses large and small increasingly require individuals with the skills necessary to respond to the demands of an increasingly complex policy terrain. Skills developed in this course include knowledge of the main theoretical approaches to understanding this terrain, and applied knowledge of a policymaking environment that encompasses multiple stakeholders. It will recognize courses that students complete that focus on developing a foundation in the politics and policy of information networks.

How to Apply:
Fill out the online application for participation in the certificate program.

Information Policy and Society
PIPC

Address:
Political Science (0130) Major Williams Hall, Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Website

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Admission Requirements

Applications for the Graduate Certificate in Information, Policy and Society will be considered from students enrolled in a graduate program at Virginia Tech and from non-degree and Commonwealth Campus students who have been permitted to take courses by the Graduate School. Certificates will be awarded upon application for the certificate and application for certificate conferral once course requirements have been completed.

Course Requirements

The certificate requires successful completion of a total of twelve credit hours, of which 9 credits are required courses and 3 are elective. Students need to receive a grade of B or better in each course to receive the certificate. Students will not be allowed to retake a course for a better grade if they receive below a B. All courses are for 3 credit hours. All students must complete:

* PSCI 5214 Contemporary Political Theory
* PSCI 5374 Electronic Governance
* PSCI 5554 Culture, Politics & Society in Network Environments

In addition, students must complete at least 3 credit hours from the following:

* PSCI 5354 Public Policy Analysis
* PSCI 5454 Advanced Topics in Information Technology and Policy

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Information Systems Design
ISDC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Graduate Certificate in Information Systems Design

In today's business environment, ad-hoc approaches to information systems development are not sufficient. Modern approaches to the development of information systems, such as structured systems development, relational database development, and object-oriented systems development, are required. The Business Information Systems module prepares the student to become a business information systems developer using both structured and object-oriented systems development approaches. It also prepares the student to design and develop business information systems that use a relational database. In this module, the student studies the strategies and techniques for dealing with the inherent complexity in the development of information systems. System development topics include coverage of (1) business systems planning; (2) fact-finding and requirements analysis techniques; (3) information systems process modeling; (4) logical and physical design; (4) user interface design; (5) introduction to database management systems and their use in business. Database topics covered include (1) data modeling, (2) normalization, (3) SQL, (4) transaction management and concurrency control, (5) physical data organization, (6) query optimization, (7) database administration, (8) distributed databases, (9) data warehousing, (10) integrating databases with the web.

The problem of efficient data storage and retrieval is one half of one of the core problems in Information Technology. The other half of that problem is determining how to use that data to decide optimal paths in complex domains.

This set of three courses in the certification in Information Systems Design will provide students with the specialized knowledge required to attack this problem domain.

How to Apply:
Fill out the online application for participation in the certificate program.

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Information Systems Design ISDC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Admissions Requirements for the Graduate Certificate Information Systems Design

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
    - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
    - Earn a minimum IELTS score of 6.5.
    - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate Information Systems Design

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

ACIS 5504 Information Systems Design & Database Concepts: Introduction to design methodologies in information systems. Structured systems analysis and design methodologies are discussed. An introduction to database design methodologies is also included. Topics related to different database models and their implementation is discussed. Students are also required to design and implement information systems using appropriate computer software.

ACIS 5524 Advanced Database Management Systems: Relates database theories and practices to concepts from other areas such as programming languages, algorithms, data structures, and information systems. The relational, network, and hierarchical models are introduced. A major portion of the course deals with data manipulation languages for the relational model, design theory for relational databases, and query optimization. Pre: ACIS 5504.

ACIS 5534 Information System Development: Study of theoretical and pragmatic approaches to the development of computer-based information systems. The emphasis is on the management of the systems development process. Strategies for managing the complexity of information systems are explored. The building of logical and physical models of systems through traditional non-executable models and executable computer prototypes. Pre: ACIS 5504.

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Information Technology Management
ITMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:* 703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Information Technology Management

The IT arena presents a specialized set of management challenges. While there is some validity to the argument that management is an abstract skill which can be employed in any setting, the management problems which typically surface in large, complex IT projects, require a basic understanding of the underlying technologies. This certificate seeks to present a useful subset of these technologies.

Learning Outcomes: Students who complete this certificate will be able to

- Gain a managerial level understanding of the role of the leader in crafting corporate and business strategies where technology provides the basis for the firm's competitive advantage.
- Develop an entrepreneurial plan for a technology start-up business.
- Distinguish the use of various business tools and strategies in managing a tech-based organization.
- Demonstrate thorough grounding in the process of designing and implementing decision support systems in business.
- Use of common software tools to develop simple decision support system implementations.

How to Apply:
Fill out the online application for participation in the certificate program.

Graduate School, Virginia Tech. Copyright 2023

Information Technology Management
ITMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:* 703/538-8384

Admissions Requirements for the Graduate Certificate in Information Technology Management

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
    - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
    - Earn a minimum IELTS score of 6.5.
    - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Information Technology Management

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

BIT 5594 Web Applications and Electronic Commerce: An examination of the concepts, technologies, and applications of electronic commerce. Topics include the World Wide Web as a platform for electronic commerce; intranets; electronic data interchange; electronic banking and payment systems; security and firewalls; software agents; and the social, legal, and international issues of electronic commerce.

BIT 5474 Computer-Based Decision Support Systems: This course explains the characteristics, use, and development of decision support systems (DSS) within the context of other business information systems. The process of designing and implementing decision support systems in business is discussed from both theoretical and practical standpoints. Students will learn various ways of measuring the success of DSS implementation as well as the difficulties associated with all such measures. Students will learn to use common software tools to develop simple DSS and will learn to use the Internet as a decision making and productivity tool.

MGT 5804 Strategic Leadership in Technology-based Organizations: This course focuses on the role of the leader in crafting corporate and business strategies where technology provides the basis for the firm’s competitive advantage.

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Integrative STEM Education
STMC

Address:
1750 Kraft Drive Room 2023
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• John G. Wells

Web Resource(s):
• PDF Form

Phone Number(s):
• *Program Area Leader:* 540/231-8471

Certificate Overview

Spring of 2006 Virginia Tech (VT) became the first university in the US to offer an *Integrative STEM Education* (I-STEM ED) graduate program. The new I-STEM ED graduate degree options were designed to develop 21st century P-20 STEM educators, leaders, scholars, and researchers prepared as catalysts of change for teaching, disseminating, and investigating integrative teaching/learning approaches to STEM education.

Our Graduate Certificate program focuses on investigating and applying new integrative, design based learning approaches to STEM education that uniquely sets us apart from other STEM programs. Integrative STEM Education is wholly consistent with, and is an exemplar of, the recommendations of the seminal STEM education reform publications of the past two decades, including Science for All Americans, Benchmarks for Science Literacy, Principles and Standards for School Mathematics, National Science Education Standards, Standards for Technological Literacy, and Educating the Engineer of 2020.

The foundation of Integrative STEM Education is Technology and Engineering Education, which remains the disciplinary base – we are the **T** and **E** in STEM education. Building on its functional role as an integrator of content and practices across disciplines (ITEA, 2000, p 6-9), I-STEM ED provides the pedagogical tenet of integrative practices where technological/engineering design based learning is an instructional requirement. The essence of the new graduate program at Virginia Tech is conveyed in how Integrative STEM Education is operationally defined.

Integrative STEM Education is defined as “technological/engineering design based learning pedagogical approaches used to ***intentionally teach*** inherent science, technology, engineering, and mathematics education content and practices ***through*** the content and practices of technology/engineering education. Integrative STEM Education is equally applicable at the natural intersections of learning within the continuum of content areas, educational environments, and academic levels” (Wells & Ernst, 2012/2015).

The term "integra**TIVE"** implies an ongoing, dynamic, learner-centered process of teaching and learning distinct from "integra**TED"** which connotes a static, completed teacher-centered process. Concepts critical in structuring this definition, and therefore the graduate program, were carefully selected, vetted over time, and employed to present a unique epistemological position. The leading concept is "technological/engineering design based" which is presented as the instructional requirement. It is immediately followed by "*intentionally*" which is italicized to emphasize its importance and refers to instructional design intent on targeting the teaching/learning of selected STEM content and practices - not only those of technology and engineering, but science and mathematics as well. This intent to teach is paramount and implies assessment of learning as a required component of the instructional design. It is central to the concept of integrative STEM education and what distinguishes the VT program from all others. The last sentence of the definition clarifies that integrative STEM education operates along an educational continuum and at natural intersects of learning - it is mutually inclusive rather than exclusive. Specifically, it does not apply solely to the STEM subjects, is applicable in both formal and informal educational settings, and is appropriate at any academic level. And finally, when using the program acronym (I-STEM ED) the "I" is capitalized so as to convey the equal significance of "integrative" along-side the S.T.E.M. elements, physically connected to those elements with a hyphen, and "education" always follows the elements to emphasize this overarching goal (Wells, 2013).

Admissions Requirements

Bachelor's degree, 3.0+ GPA (min.) in final 60 Semester Hour (SH) of bachelor's degree program; Undergraduate Transcripts; Resume

Course Requirements

To be awarded the Graduate Certificate in Integrative STEM Education students must successfully complete the following 12 semester hours (SH) of coursework* offered by the Integrative STEM Education Program at Virginia Tech:

EDCI 5804: STEM Education Foundations (3 SH)

EDCI 5814: STEM Education Pedagogy (3 SH)

EDCI 5774: Readings in Technology Education (3 SH)

and one of the following:

EDCI 5854: Biotechnology Literacy by Design (3 SH)

EDCI 5824: STEM Education Trends and Issues (3 SH)

*Note: All coursework for this Graduate Certificate is available both on-campus and virtually via synchronous audio/video web-conferencing.

How to Apply:
Fill out the online application for participation in the certificate program.

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Integrative STEM Education
STMC

Address:
1750 Kraft Drive Room 2023
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• John G. Wells

Web Resource(s):
• PDF Form

Phone Number(s):
• *Program Area Leader:*
540/231-8471

Admission Requirements

---Bachelor's degree, 3.0+ GPA (min.) in final 60 Semester Hour (SH) of bachelor's degree program; Undergraduate Transcripts; Resume

Course Requirements

To be awarded the Graduate Certificate in Integrative STEM Education students must successfully complete the following 12 semester hours (SH) of coursework* offered by the Integrative STEM Education Program at Virginia Tech:

EDCI 5814: STEM Education Pedagogy (3 SH, fall semester only)

EDCI 5804: STEM Education Foundations (3 SH, fall semester only)

EDCI 5774: Readings in Technology Education (3 SH, fall & spring semester)

and one of the following:

EDCI 5854: Biotechnology Literacy by Design (3 SH, spring semester only)

EDCI 5824: STEM Education Trends and Issues (3 SH, spring semester only)

*Note: All coursework for this Graduate Certificate is available both on-campus and virtually via synchronous audio/video web-conferencing.

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Interdisciplinary Water and Health Science
IWHC

Address:
22-A Food Science and Technology Building (0418), 360 Duck Pond Drive
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. David Kuhn

Web Resource(s):
• Water INTERface official website
• Water INTERface Blog

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Graduate Certificate In Interdisciplinary Water and Health Science

Clean water is a common topic discussed in many classrooms and research laboratories around this campus. Yet, the complexity of societal issues related to water shortages, hygiene, and quality, which influence water consumption and its role in human health, highlights the importance of increased interdisciplinary dialogue and problem-solving capabilities. The certificate reflects the acquisition of this interdisciplinary knowledge as related to “water and health.”

This certificate program is available to graduate students who are affiliated with the Water INTERface (WI) IGEP – at either the MS or PhD level. Students who successfully complete the 9 credits of WI IGEP coursework are eligible to apply to receive the certificate. Students may be affiliated with any department with WI IGEP mentorship agreement by a certificated WI IGEP Faculty (see website).

The IGEP is a non-degree granting program, thus students have a home department (i.e., that of their graduate advisor) with specific degree requirements. The water (WI IGEP) graduate certificate reflects the successful completion of the interdisciplinary coursework (including a 2 credit hour independent research project), which includes content related to four interdisciplinary research thematic areas:

· Public Perception: public perception of technological options and advancements for providing clean water resources (water treatment);

· Risks: risks (perceived or real) associated with contaminants and water-borne infectious diseases in private homes, public water systems, and commercial food processing facilities;

· Chemistry: role of water chemistry (e.g., mineral composition) in delivering functional qualities such as flavor and bioavailable nutrients;

· Health: role of water consumption in health, wellness, and mitigation of mineral deficiencies and diseases.

How to Apply:
Fill out the online application for participation in the certificate program.

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Interdisciplinary Water and Health Science
IWHC

Address:
22-A Food Science and Technology Building (0418), 360 Duck Pond Drive
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. David Kuhn

Web Resource(s):
• Water INTERface official website
• Water INTERface Blog

Phone Number(s):

Admission Requirements: Graduate Certificate In Interdisciplinary Water and Health Science

Certificate applicants must have a baccalaureate degree or the equivalent of a US four-year degree from a regionally accredited institution, and must have been accepted (or are currently enrolled) in a degree-granting graduate program at Virginia Tech.

A minimum GPA of 3.0/4.0 is required to apply for the graduate certificate. Students who wish to apply to pursue the certificate should contact the program director, Dr. Susan Duncan and Dr. Andrea Dietrich (WI IGEP Program Directors and certificate coordinators). The applicant must have approval from WI IGEP Directors and agreement from a WI IGEP faculty mentor who are different from applicant's home department for the 5974 Independent Study. A formal request for admittance identifies and confirms the approval from applicant's WI IGEP research mentor (5974 Independent Study) and from applicant's thesis/dissertation advisor. Application for admittance includes the application for certificate (application form), letter of approval from thesis/dissertation advisor, letter of agreement from WI IGEP faculty mentor, CV, statement of interest, official transcript, GRE score report, and graduation certificates of baccalaureate degree or the equivalent of a US four-year degree from a regionally accredited institution (all materials can be submitted as electronic version).

Course Requirements: Graduate Certificate In Interdisciplinary Water and Health Science

Students will increase knowledge, advocacy, and comprehension of the four thematic areas (public perception, risk, chemistry, health) through the required certificate coursework, in addition to completing the graduate degree requirements of their home department. Students will explore critical thinking of the thematic areas in literature reviews and meeting research objectives in their course discussions, research activities, and dissertations. The IGEP certificate courses are as follows:

- Ethics course (complete one of the following:
  - Advanced Interdisciplinary Issues and Ethics in Water Resources (GEOG 5134) (3 credits)
  - Research Ethics in Agriculture and Life Sciences (ALS 5324) (3 credits)
  - Engineering Ethics and the Public (CEE 5804) (3 credits)
- Interdisciplinary Research (GRAD 5134) (3 credits)
- Water for Health Seminar (GRAD 5414) (1 credit)
- Independent Research Study (GRAD 5974) (2 credits)

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International Hospitality and Tourism Strategy
IHTC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Professor Mahmood Khan

Web Resource(s):
• Website

Phone Number(s):
• *Mahmood Khan:* 703/538-8486

Certificate Overview | Admissions & Course Requirements

International Hospitality and Tourism Strategy Overview

Applications for the Graduate Certificate in International Hospitality and Tourism Strategy will be considered from students enrolled in a graduate degree program at Virginia Tech and from non-degree and Commonwealth Campus students who have undergraduate degrees. Certificates will be awarded upon application for the certificate conferral once course requirements have been completed. The certificate has been designed so that both degree and non-degree seeking students from other majors may take the three courses within one semester and complete the certificate.

The purpose of this certificate is to provide middle managers in the Hospitality and Tourism industry with the tools and skills required to prepare them to engage in high-level strategic thinking and analysis on a global scale. In particular, this certificate will provide specific methods to utilize as part of their analysis and understanding of international markets and trends in HTM and ultimately allow certificate holders to compete for upper level managerial positions.

Upon completion students will be able to:

- Apply the concepts of international strategic management and competitive strategy to the hospitality industries.

- Analyze and develop strategies to address contemporary issues in the international business environment facing multinational service firms in the hospitality industry, including global strategy formulation and implementation; technology challenges; diversity in customers and employees; political and legal concerns; and effective organizational structures for long term survival.

- Analyze current macro dimensions of international marketing, e.g., culture, politics, and economics; international comparative marketing systems; international marketing management decisions; and international strategic planning and control and extrapolate these dimensions to the hospitality industry.

How to Apply:
Fill out the online application for participation in the certificate program.

International Hospitality and Tourism Strategy
IHTC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Professor Mahmood Khan

Web Resource(s):
• Website

Phone Number(s):
• *Mahmood Khan:* 703/538-8486

International Hospitality and Tourism Strategy Admission Requirements

Graduate certificates can be awarded to individuals who do not desire to work toward a degree as well as to students who are working on graduate degrees. Interested students must submit an official copy of their college transcript or diploma documenting receipt of a bachelor's degree from a regionally accredited college or university with an acceptable grade point average mailed to the Virginia Tech Graduate School as part of the application process. Please contact us for specific instructions on applying online. Students should meet with an academic adviser familiar with the classes on the list below and submit the application form to the HTM Graduate Administrator for Certificate Program Approval signature no less than six months prior to completion of coursework.

International Hospitality and Tourism Strategy Course Requirements

Number of Credit Hours: 9 credit hours. Transfer credits are not permitted.

Required Courses:

HTM 5534 Strategic Management and Competitive Strategy in the Hospitality Industries. To enable students to develop a comprehensive understanding of the concepts of strategic management and competitive strategy as applied to the hospitality industries. (3H, 3C)

HTM 5024 International Service Management. Overview of the contemporary issues in the international business environment facing multinational service firms in the hospitality industry. These issues include such topics as: global strategy formulation, and implementation; technology challenges; diversity in customers and employees; political and legal concerns; and effective organizational structures for long term survival. (3H, 3C)

Restricted Elective Courses:

Choose one of the following:

MGT 5784 International Management. This course focuses on the management challenges associated with the development of strategies and the management of organizations in business enterprises whose operations stretch across national boundaries. It will provide students with the knowledge, skills, and sensitivities that will help them manage more effectively in an international environment. (3H, 3C)

MKTG 5704 International Marketing Strategy. This course provides the background to make managerial marketing decisions at the international level. It is composed of four sections: macro dimensions of international marketing, e.g., culture, politics, and economics; international comparative marketing systems; international marketing management decisions;

and international strategic planning and control. (3H, 3C)

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International Research Abroad
IRAC

Address:
Graduate School (MC 0325), Graduate Life Center, Virginia Tech, 155 Otey ST NW
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• William Huckle
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *William Huckle:* 540/231-5645
• *Graduate School Admissions:* 540/231-8636

Certificate Overview | Admissions & Course Requirements

Certificate Overview

In keeping with the global dimensions of Virginia Tech's research mission, many faculty and graduate students are engaged in research partnerships with scholars from numerous other countries. Students who engage in research while living in other countries can gain valuable disciplinary expertise as well as deep understanding of cultural dimensions of research that are essential for fruitful global endeavors. This certificate provides a means of recognizing students' efforts and accomplishments in gaining background knowledge required for successful international research collaborations and in conducting research abroad.

Eligible Students

- VT master's and doctoral students from multiple disciplines who are US citizens, including US permanent residents, seeking specialized research experiences in another country
- International VT master's and doctoral students from multiple disciplines who are seeking specialized research experiences in a country other than the US and countries where they have studied before (pending visa regulations)
- Students seeking degrees at universities in other countries who enroll at Virginia Tech as guest students for the purpose of gaining specialized research experience in the US

How to Apply:
Fill out the online application for participation in the certificate program.

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Contact Us | Privacy Policy

International Research Abroad
IRAC

Address:
Graduate School (MC 0325), Graduate Life Center, Virginia Tech, 155 Otey ST NW
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• William Huckle
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *William Huckle:* 540/231-5645
• *Graduate School Admissions:* 540/231-8636

Certificate Overview | Admissions & Course Requirements

Admission Requirements

- Meet Graduate School criteria: Completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better and English language proficiency
- Students enrolled in Virginia Tech degree programs must also meet the admission criteria for their programs

Course Requirements

The Graduate Certificate in International Research Abroad requires a minimum of 9 credits; these credits may be listed as part of the degree Plan of Study where permitted by program degree requirements.

- GRAD 5404, Research in International Contexts, 3 cr, graded A-F
- 3-cr elective focusing on knowledge and research expertise required to prepare for the international research abroad experience, must be graded a-F
- 3 or more cr of 5904, 5994, or 7994 based on research conducted abroad in collaboration with a scholar abroad, graded EQ by a VT faculty member who serves as instructor of record for the credits (each 3 cr requires a minimum of 6 weeks of full-time research work abroad)

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Internet and Network Technologies
INTC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:* 703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Internet and Network Technologies

Today we take for granted sending emails, streaming movies, and buying and selling products online. What started with just a few connected universities in the 1960s, the Internet now connects computers and networks across the world, allowing people and devices to communicate and share information through wired and wireless protocols. In fact, with the Internet of Things, the internet is so pervasive in our lives that understanding how these networks work as well as how they can be used securely is essential knowledge in Information Technology. Internet and Network Technologies Certificate will provide students with the specialized knowledge required to understand this problem domain.

How to Apply:
Fill out the online application for participation in the certificate program.

Internet and Network Technologies
INTC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Admission Requirements for the Graduate Certificate in Internet and Network Technologies

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor’s degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
  - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
  - Earn a minimum IELTS score of 6.5.
  - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Course Requirements for the Graduate Certificate in Internet and Network Technologies

Number of Credit Hours:

A total of nine credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

ECE 5484 Fundamentals of Computer Systems: Fundamental principles and concepts of computer systems. Computer hardware; Boolean logic; number systems and representation; design and operation of digital logic; analysis of instruction set architectures and computer organization; and specification of data communication and networking standards. Pre: Programming language experience (C++, C#, Java).

ECE 5485 Networks and Protocols: Fundamental principles and concepts of computer networks; application, transport, network, and data link protocols. Contemporary and emerging networks; Internet protocols. Principles of quality of service, network security, and network management. Pre: ECE 5484.

ECE 5480 Cybersecurity and the Internet of Things: Cybersecurity principles and technologies motivated by the evolving ecosystem of the Internet of Things (IoT): devices, operating systems, sensors, data storage, networking and communication protocols, and system services. IoT device and system security and privacy vulnerabilities, analysis and attack mitigation techniques. Pre: ECE 5484 or CS 5044.

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Contact Us | Privacy Policy

Leadership for an Aging Society
ASCC

Address:
230 Grove Lane (0555)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Center for Gerontology

Web Resource(s):
• Website

Phone Number(s):

Overview of the Graduate Certificate in Leadership for an Aging Society

The Graduate Certificate in Leadership for an Aging Society is designed to teach students the fundamental components of the aging process and leadership skills needed to ethically manage an organization that serves older adults. Students will learn how to develop, implement, and assess organizational policy and lead teams that provide support services for older adults. The program also covers a variety of topics related to serving in a leadership role in the elder care industry such as the biological, psychological, and sociological impacts of aging; ethical issues surrounding older adults and their families living in community and/or facility settings (e.g., for-profit, nonprofit, government); and public policy development and approval processes at local, state, and national levels. Graduates will be prepared to lead and manage entities that serve older adults in a variety of settings, including private and public organizations.

This graduate certificate will principally serve two broad audiences:

- Current professionals whose organizations specialize in assisting/caring for older adults in public or private settings; and
- Graduate students enrolled in a degree program related to aging (such as sociology, engineering, agriculture, nutrition, public administration, or human development).

How to Apply:
Fill out the online application for participation in the certificate program.

Leadership for an Aging Society
ASCC

Address:
230 Grove Lane (0555)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Center for Gerontology

Web Resource(s):
• Website

Phone Number(s):

Admission Requirements

Degree seeking and non-degree seeking students will have to apply to the graduate certificate program.

Degree seeking students will:

- Submit a Graduate Certificate Application
- Submit official transcript
- Possess a bachelor's degree from an accredited institution with a GPA of 3.0 or better

Non-degree seeking students will:

- Submit a Graduate School Application for Admission
- Submit a Graduate Certificate Application
- Submit official transcripts
- Possess a bachelor's degree from an accredited institution with a GPA of 3.0 or better

Students who have not earned a degree in the United States must submit:

- Test of English as a Foreign Language (TOEFL) with a minimum score of 90 on the internet-based test (iBT) or the International English Language Testing System (IELTS) with a minimum score of 6.5
- TOEFL scores of 20 or greater in Listening, Writing, Speaking, and Reading subsections

Course Requirements

Curriculum Requirements

Students will be required to complete coursework to develop knowledge and skills related to organizational leadership, ethical principles, and public policy for the aging services network. Students will also be required to apply organizational leadership skills in a capstone project to develop, execute, and/or assess an elder care policy or program. Students will gain an understanding of the fundamental competencies needed to lead aging services organizations and manage teams that develop and implement policies and practices that address the care needs of older adults and their families.

Total Number of Credit Hours:

12 graduate credit hours

Core Courses:

- LAHS 5004: Organizational Leadership for an Aging Society (3 credits)
- LAHS 5014: Ethics for an Aging Society (3 credits)
- LAHS 5024: Public Policy for an Aging Society (3 credits)
- LAHS 5034: Gerontology Leadership Capstone Project (3 credits)

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Learning Sciences
LSCC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Kathy Cennamo

Web Resource(s):
• PDF Form

Phone Number(s):
• *Phone:*
540/231-9122

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in the Learning Sciences

The Certificate in the Learning Sciences provides an advanced understanding of learning in formal and informal environments, integrating perspectives from instructional design and technology, educational psychology, and social foundations of education. Students who complete the Graduate Certificate in the Learning Sciences will have demonstrated requisite knowledge and skills necessary to conceptualize, design, deliver, and measure effective learning. The Graduate Certificate in the Learning Sciences is appropriate for advanced graduate students considering careers such as higher education faculty, research scientists, educational administrators, funding agency program directors, and policy makers.

How to Apply:
Fill out the online application for participation in the certificate program.

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Contact Us | Privacy Policy

Learning Sciences
LSCC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Kathy Cennamo

Web Resource(s):
• PDF Form

Phone Number(s):
• *Phone:*
540/231-9122

Certificate Overview | Admissions & Course Requirements

Admission Requirements

To complete the Graduate Certificate in the Learning Sciences, students must be enrolled currently and in good standing in any graduate program at Virginia Tech. Students considering the Certificate should consult with faculty in one of the associated programs to plan their study to be consistent with prior experience, career goals, and certificate requirements.

Course Requirements

Students must take at least twelve credit hours in the options listed below. All students are required to enroll in EDIT 5234, Introduction to the Learning Sciences. Students will then choose one elective, equal to a three-credit-hour course, from *three* of the other *four* categories listed below, Cognition, Design, Social Foundations, and Technology. The order of these courses, including EDIT 5234, may be taken at the discretion of the student after consulting with his or her advisor.

a. Introductory Course (Required for Certificate)

EDIT 5234: Introduction to the Learning Sciences

b. Courses in Cognition

EDEP 5114: Learning and Cognition
EDEP 6114: Cognitive Processes and Educational Practice
EDEP 6224: Constructivism and Education
EDEP 6444: Motivation and Cognition

c. Courses in Design

EDIT 5164: Design for Learning*
EDIT 6334: Applied Theories of Learning*
EDIT 5224: Principles for Learning Message Design

d. Courses in Social Foundations

EDEP 5184: Sociocultural Influences on Learning and Instruction
EDCI 6024: The Analysis of Educational Concepts

e. Courses in Technology

EDEP 6334: Multimedia Cognition
EDIT 5594: Topics in Learning Environment Design and Development
EDIT 5614: Digitally Mediated Learning
EDIT 5634: Interactive Learning Media Development

* Prior permission of instructor required for non-degree students outside Instructional Design and Technology or Educational Psychology

Application Process

When students decide to obtain the certificate, they should complete the Application - Certificate (Graduate Certificate Application). This form starts the process, designating the courses that will be taken for the certificate. Applicants should follow the directions on the form for returning it to the Graduate School. During the semester in which the certificate requirements are to be completed, students should complete and return the Application for Degree or Certificate Conferral. Both of these forms are available from the "Forms" section of the Graduate School's home page https://graduateschool.vt.edu/academics/what-you-need-to-graduate/forms.html

Certificate Faculty

The following faculty members of the School of Education are affiliated with the Graduate Certificate in the Learning Sciences:

Dr. Katherine Cennamo
Dr. Peter Doolittle
Dr. Glen Holmes
Dr. Brett Jones
Dr. Barbara Lockee
Dr. Ken Potter
Dr. Marcus Weaver-Hightower
For general inquiries regarding the certificate, please contact Katherine Cennamo (cennamo@vt.edu, 540-231-9122).

Local Government Management
LGMC

Address:
Center for Public Administration and Policy 104 Draper Road (0520) Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Stephanie Davis

Web Resource(s):
• Program Website
• Program Website

Phone Number(s):
• *Stephanie Davis:* 804/980-5549
• *Colleen Malley:* 540/231-5133

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Local Government Management

The Virginia Tech Center for Public Administration and Policy (CPAP), in partnership with the Virginia Local Government Management Association (VLGMA), has developed a graduate certificate program in local government management that helps to address the workforce development need for highly qualified public managers in local government. The central goal of the program is to offer graduate-level training in local government management that both prepares pre-career students for capable public service at the local level and enhances the capacities of existing local government employees who aspire to be town, city, or county managers or assistant/deputy managers.

The certificate program consists of four 3-credit hour courses, for a total of twelve hours of graduate coursework. Students are required to complete all four courses with a GPA of 3.0 or better in order to earn the certificate. Students are exposed to a full spectrum of local government issues, service delivery options, and management tools. The analysis of an actual local government case study is central to each classroom experience. Case studies are used within the courses to emphasize the relationship between the political and management worlds which all local government managers must understand and navigate in order to be successful. All courses are taught by experienced, highly qualified local government practitioners.

How to Apply:
Fill out the online application for participation in the certificate program.

Local Government Management
LGMC

Address:
Center for Public Administration and Policy 104 Draper Road (0520) Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Stephanie Davis

Web Resource(s):
• Program Website
• Program Website

Phone Number(s):
• *Stephanie Davis:* 804/980-5549
• *Colleen Malley:* 540/231-5133

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Non-degree candidates may apply for admission to the certificate program using the Virginia Tech Graduate School's online application system found at Admissions. Interested students must submit an official copy of their college transcript documenting receipt of a bachelor's degree from a regionally accredited college or university with an acceptable grade point average mailed to the Virginia Tech Graduate School as part of the application process. Current MPA students should discuss their plans with the certificate director before applying for the certificate. If approved, 3 credit hours can be used as a core course substitution (personnel or budgeting course) for the MPA degree and 9 credit hours used towards the MPA elective courses. Transfer credits are not permitted for the Certificate program.

Course Requirements

Students are required to complete four courses with a GPA of 3.0 or better to earn the certificate. The Certificate offers five course options.

Required Courses:

- PAPA 5044 Local Government and the Professional Manager
- PAPA 6354 Advanced Topics in Public Management: Human Resource, Financial, and Performance Management for Local Government Managers
- PAPA 6154 Advanced Topics in Public Organizations: The Context of Local Government Management in Virginia
- UAP/PAPA 5874 Local Economic Development Planning
- UAP 5184 Planning Administration

On-line certificate

The local government certificate program is offered as a synchronous on-line program using Zoom as the digital platform. The program is offered both in-state and out-of-state.

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Material Culture and Public Humanities
MCHC

Address:
203 Draper Road
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Aaron Ansell
• Michelle Moseley

Web Resource(s):
• Material Culture & Public Humanities

Phone Number(s):
• *Aaron Ansell:* 540/231-0491
• *Michelle Moseley:* 540/231-5547

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Material Culture and Public Humanities

This is a cross-disciplinary graduate certificate comprised of 9 credits of key coursework in the MA Program in Material Culture and Public Humanities. These courses focus on material objects and their placement in theoretical, cultural, and historical perspectives, as well as public representations of a wide range humanities-based knowledge. As such, the Certificate prepares students for careers in museums, historical societies, and other cultural organizations.

The MCPH Certificate is geared both to VT graduates in other MA/PhD programs who wish to focus on themes of material culture and public humanities, and to scholars from outside the VT community who may wish to pursue continuing education as "Commonwealth Campus" students in this non-degree program.

Most of the courses on the Certificate curriculum are either already accessible to distance learners or can be adapted for distance learners upon conversation with the instructor.

See the MCPH Website (www.mcph.liberalarts.vt.edu) for further information or contact one of the Graduate Directors, Dr. Aaron Ansell (aansell@vt.edu) or Dr. Michelle Moseley (mymc@vt.edu).

How to Apply:
Fill out the online application for participation in the certificate program.

Material Culture and Public Humanities
MCHC

Address:
203 Draper Road
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Aaron Ansell
• Michelle Moseley

Web Resource(s):
• Material Culture & Public Humanities

Phone Number(s):
• *Aaron Ansell:*
540/231-0491
• *Michelle Moseley:*
540/231-5547

Admission Requirements

- Students already enrolled in other VT graduate (MA or PhD) degree programs may apply for the MCPH Certificate by filling out the Graduate Certificate Application form in consultation with one of the two co-directors of the MCPH program, Drs. Aaron Ansell (aansell@vt.edu) and Michelle Moseley (mymc@vt.edu).

  Scholars from outside the VT community who wish to pursue an MCPH Certificate can do so by applying for graduate study via the Commonwealth Campus (see link). They will need to submit a transcript (unofficial is sufficient) or a copy of their diploma for the highest degree attained. (No graduate entrance exams are required.) For more information about the Commonwealth Campus see this link.

  All students seeking admission to the MCPH Certificate program should contact one of the Graduate Directors, Dr. Aaron Ansell (aansell@vt.edu) or Dr. Michelle Moseley (mymc@vt.edu).

Course Requirements

The certificate requires 9 credit hours, distributed as follows:

3 Credits Foundational Coursework, either

ART/HUM/RLCL 5104: Research Methods in Material Culture and Public Humanities (3H, 3C

Investigation of methodologies with specific application to cultural objects situated in the public sphere

Or

ART/HUM/RLCL 5204: Research Methods in Material Culture and Public Humanities (3H,3C)

Topics cover steps for developing an installation, from analysis, archiving, to writing and interpretation for various audiences.

6 Credits Electives from the following courses

ART 5584: Topics in Material Culture (3H, 3C)

Advanced seminar. Provides a comprehensive examination of various periods and subjects of material culture through rotating topics. Topics indicated by timetable. May be repeated for credit for a maximum of 9 credits. Graduate standing required.

HUM/RLCL 5584: Topics in Public Humanities (3H, 3C)

Advanced seminar on topics in public humanities, ranging from an exploration of how various humanities disciplines relate to public issues and concerns, to a study of region, regionalism, and place in public humanities. May be repeated with different topic content for a maximum of 9 credits. Pre-requisite: Graduate Standing required.

HUM/RLCL: Material Culture and Humanities in the Public Sphere (3H, 3C)

Advanced seminar on material culture and humanities in the public sphere through an examination of humanistic approaches to civic spaces, applying critical turns to public debates.

RLCL 5124/ASPT 5124: Religion & Modernity in the West (3H, 3C)

A study of the relationship between religion and modernity in the West, with analysis of whether modern society is "disenchanted" or "secularized," or whether religion has remained a potent force in western society and thought. Through a survey of some of the major thinkers and themes of modern religious thought, we will consider the philosophical, economic, political, and legal aspects of the location of religion in the modern world. Pre: Graduate standing.

ART 5984: Exhibition, Design, and Display (3H, 3C)

Focus on the display and presentation of visual art, using local (including university) galleries and sites as venues for student-designed exhibitions. Provides experience in the public art arena, and practical knowledge about planning, designing and mounting exhibitions.

HIST 5424: Public History (3H, 3C)

Introduction to the theoretical, interpretive, controversial, and practical issues facing public historians. Focus on interpretations and specific issues surrounding the presentation of history in museum exhibits, documentary films, photographic collections, community history projects, the Internet, and a variety of other public venues.

With permission from a MCPH co-director, any other 5000 or 6000-level course in VT's Graduate Catalogue (including independent studies) can count toward the elective requirement.

See the MCPH Website (https://www.mcph.liberalarts.vt.edu/course-descriptions/) for further information about our courses.

Mechanical Engineering Professoriate
MPRC

Address:
105 Randolph Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Corina Sandu, Professor, Associate Department Head for Graduate Studies
• Cathy Hill, Graduate Program Coordinator

Web Resource(s):
• Mechanical Engineering Graduate Student Website

Phone Number(s):
• *Cathy Hill, Graduate Program Coordinator:* 540/231-7460

Certificate Overview | Admissions & Course Requirements

Overview

The purpose of the certificate program is to educate students about the roles faculty have in a higher education setting. Students will learn about aspects of an academic career including teaching strategies, ethical behavior, promotion and tenure, and leadership. Students will gain knowledge in how to effectively communicate in the classroom and to initiate and fund research. Students will study issues facing higher education. Graduates will be prepared to develop and teach courses, mentor and advise students, and collaborate with other faculty members.

How to Apply:
Fill out the online application for participation in the certificate program.

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Mechanical Engineering Professoriate
MPRC

Address:
105 Randolph Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Corina Sandu, Professor, Associate Department Head for Graduate Studies
• Cathy Hill, Graduate Program Coordinator

Web Resource(s):
• Mechanical Engineering Graduate Student Website

Phone Number(s):
• *Cathy Hill, Graduate Program Coordinator:* 540/231-7460

Admission Requirements

This certificate is geared toward doctoral students in the Department of Mechanical Engineering.
The applicant must:

- Be a currently enrolled, full-time doctoral student in the Department of Mechanical Engineering with a GPA of 3.3 or better.
- Submit a Graduate Certificate Application.

Course Requirements

Core Courses: 8 credits
GRAD 5104: Preparing the Future Professoriate (3 credits)
ME 5014: Graduate Assistant Training for the Mechanical Engineering Professoriate (3 credits)
ME 6014: Mechanical Engineering Professoriate Preparation Seminar (2 credits)

Required Course: 1 credit
GRAD 5004: GTA Training Workshop (1 credit)

Restricted Elective Course: 3 credits
Students choose one course from the following list of courses.
ENGE 5024: Design in Engineering Education and Practice (3 credits)
ENGE 5604: Engineering Education Research Methods (3 credits)
GRAD 5114: Pedagogical Practices in Contemporary Contexts (3 credits)
GRAD 5214: Diversity and Inclusion in a Global Society (3 credits)

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Middle East Politics and Society
MEPC

Address:
900 N. Glebe Rd., School of Public and International Affairs, Virginia Tech
Research Center-Arlington
Arlington , VA 22203

Contact this Certificate

Email Contact(s):
• Ariel Ahram

Web Resource(s):
• MEPS

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This certificate provides students with the tools to interpret, analyze, and assess contemporary politics and society in the Middle East. The certificate focuses on the politics, society, and history of the peoples of North Africa, Southwestern Asia, Asia Minor, and the Arabian Peninsula, related borderlands and island groups, and including emigrant and immigrant groups. The certificate addresses the causes and consequences of conflict in the region, the impact of external interventions, including colonialism, and the drivers of political and social change. Having successfully completed the certificate students will be able to: 1) apply theories of cultural and social change to describe how culture and religion affects politics in the Middle East; 2) assess how external involvement have shaped the region's domestic and international politics; 3) analyze issues on comparative political theory pertaining to the methods of political representation, the status of women, minorities, and role of religion in Islamic polities; and 4) explain different approaches to conflict resolution as pertains to various political, economic, ethnic, and geopolitical struggles in the Middle East.

How to Apply:
Fill out the online application for participation in the certificate program.

Middle East Politics and Society
MEPC

Address:
900 N. Glebe Rd., School of Public and International Affairs, Virginia Tech
Research Center-Arlington
Arlington , VA 22203

Contact this Certificate

Email Contact(s):
• Ariel Ahram

Web Resource(s):
• MEPS

Phone Number(s):

Admission Requirements

Applications for the Graduate Certificate in Middle East Politics and Society will be considered from students enrolled in a graduate degree program at Virginia Tech and from non-degree and Commonwealth Campus students who have been permitted to take courses by the Graduate School. Certificates will be awarded upon application for the certificate and application for certificate conferral once course requirements have been completed.

Non-degree seeking applicants

A person who wishes to enter Virginia Tech to obtain a graduate certificate, without being enrolled in a degree program, may apply for admission to Graduate Certificate status. Such applicants submit an Application for Admission and a Graduate Certificate Application, and

must meet the following criteria:

• GPA of 3.0 for the last half of the credits earned for the undergraduate degree,

• Submission of official transcripts,

• academic background appropriate for the Certificate, and

• International applicants must submit scores from the Test of English as a Foreign

Language (TOEFL) with a minimum of 550 paper-based (PBT) or 80 internet-based test (iBT), or the International English Language Testing System (IELTS) with a minimum score of 6.5.

Non-degree seeking applicants will be required to get permission of instructor before enrolling inindividual classes.

Course Requirements

Total Number of Credit Hours: 9 credit hours. Transfer credits are not permitted.

Required courses—9 credits

Students will choose three courses:

• GIA 5314 Middle East Geopolitics (3 cr)

• GIA/PSCI 5614 (HIST 5544)Understanding the Israeli Palestinian Conflict (3 cr)

• ASPT 5134 Islamic Political Thought (3 cr)

• ASPT/HIST/RLCL 6124 (PSCI 6234) Pre-Modern Christian and Islamic Political Theory (3 cr)

Another 5000-level or 6000-level course subject to approval by the certificate candidate’s advisor.

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Mission Engineering
MENC

Address:
1145 Perry Street, 250 Durham Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Taylan Topcu

Web Resource(s):
• ISE Graduate Certificates

Phone Number(s):
• *Program Coordinator:* 540/231-1839

Description of Certificate

Description of Certificate

The Graduate Certificate in Mission Engineering is designed to teach students engineering methods to design, develop, and assess complex system-of-systems using mission engineering tools and practices in combination with the tactical insights of operational planning. Students will learn how to identify mission-level operational needs to develop clear problem statements and apply mission engineering techniques to translate these needs into specific programmatic guidance for critical programs. The program covers topics related to mission execution (including mission safety, security, integration, and interoperability) and mission development (including cost estimating, mission fragmentation risk analysis, mission thread development, and mission experimentation, modeling, and simulation). Graduates will be prepared to analyze complex problems, evaluate alternative mission concepts, and design and plan mission solutions.

Target Audience
The certificate will have two target audiences: 1) graduate students currently enrolled in a graduate degree program related to systems engineering (e.g., aerospace engineering, ocean engineering, electrical engineering, civil engineering, etc.), and 2) current systems and mission engineering professionals in organizations. These organizations are focused on technological advances to field new capabilities by developing future investments in science and technology based on the identification of actual gaps in complex system-of-systems across multiple industrial sectors to include Defense, Transportation, Health Care, Education, Space Exploration, and Homeland Security.

Time to Complete
Full-time and part-time students may enroll in the certificate program. Degree-seeking students may take courses in conjunction with their regular course load. Students attending full-time can complete the certificate in a minimum of one academic year (two semesters) and a maximum of three academic years (six semesters). Degree-seeking students attending part-time can complete the certificate in approximately two academic years (four semesters) and a maximum of four academic years (eight semesters). Non-degree seeking, full-time students can complete the certificate in a minimum of one academic year (two semesters). Non-degree seeking, part-time students, taking one course per semester, can complete the certificate in two academic years (four semesters).

How to Apply:
Fill out the online application for participation in the certificate program.

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Mission Engineering
MENC

Address:
1145 Perry Street, 250 Durham Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Taylan Topcu

Web Resource(s):
• ISE Graduate Certificates

Phone Number(s):
• *Program Coordinator:* 540/231-1839

Admission

Admission

All students will be required to apply to the certificate program. The admission requirements will be based on enrollment status at the institution.

Degree-seeking students will:

- Submit a Graduate Certificate Application
- Possess a bachelor’s degree in any engineering discipline from an accredited institution with a GPA of 3.0 or better

Non-degree seeking students will:

- Submit a Graduate School Application for Admission and pay the fee
- Submit a Graduate Certificate Application and pay the fee
- Possess a bachelor’s degree in any engineering discipline from an accredited institution with a GPA of 3.0 or better
- Submit official undergraduate transcripts demonstrating bachelor’s degree conferral
- Submit a statement describing their experience in systems engineering and/or mission engineering roles

Students who have not earned a degree in the United States must submit:

- Test of English as Foreign Language (TOEFL) minimum score of 90 on the internet- based test (iBT) (and scores of 20 or greater in Listening, Writing, Speaking, and Reading subsections) or the International English Language Testing System (IELTS) with a minimum score of 6.5

Curriculum

Curriculum Requirements and Description

The curriculum requires coursework to develop students’ knowledge of mission design and development (e.g., mission thread analysis, platform development) and mission planning and management (e.g., distributed governance, capability allocation). Students will learn about designing, developing, and managing engineering missions. Students will gain an understanding of how managerial and governance independence in systems-of-systems demand the application of mission engineering methods to guarantee sustainment of mission capabilities. Students will learn how to use mission engineering methods to identify and capture heterogeneous operational needs, select, and analyze mission threads, and plan the deployment and governance of mission components within a systems-of-systems context.

Program requirements

Number of Credit Hours: 12 credit hours of graduate level courses

Courses:

- ISE 5814 System Dynamics Modeling of Socio-Technical Systems (3 credits)
- ISE 5834 Decision Analysis for Engineers (3 credits)
- ISE 5854 Mission Engineering I (3 credits)

- ISE 5864 Problem Formulation and Decomposition (3 credits)

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Multidisciplinary Research in International Development
IRDC

Address:
Global Education Office, 526 Prices Fork Road, Suite 131 (0378)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• website

Phone Number(s):
• *phone:*
540/231-5888

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Graduate Certificate in Multidisciplinary Research in International Development allows graduate students already working towards a graduate degree to attain special recognition for work pertaining to international development. It is designed to encourage students to broaden their academic experiences while enabling them to better face international challenges. The program can offer interested students guidance in the choice of electives, course alternatives within the discipline, and thesis topics.

International development is a process of improving the lives of people in developing countries. It has three components: education and training, collaborative research, and technical assistance. Development work is multidisciplinary in nature, often involving members of several disciplines working together to define a common goal. No single discipline can provide a thorough understanding of the development process. The Graduate Certificate in Multidisciplinary Research in International Development promotes a multidisciplinary approach on the part of the student.

How to Apply:
Fill out the online application for participation in the certificate program.

Multidisciplinary Research in International Development
IRDC

Address:
Global Education Office, 526 Prices Fork Road, Suite 131 (0378)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• website

Phone Number(s):
• *phone:*
540/231-5888

Admission Requirements

You must register no later than the last day to add courses of your last semester. Additionally, you must:

--be accepted as a graduate student in an established academic department;
--have at least one faculty member with experience in international development on your graduate committee;
--have your application signed by your major professor

course requirements and other requirements

--Take at least three courses from the approved list (contact the certificate administrator to discuss using courses that are not on the approved list)

--Ensure that one course is outside your department, and one course is outside your college
--Independent and special studies are accepted but must be relevant to international development and must be approved by the certificate advisory committee
--Write your thesis or major paper on a topic related to international development
--Make a presentation on your research prior to completion of the certificate
--The requirement for a course within your department may be fulfilled with an overseas research experience conducted in conjunction with completion of the course *GRAD 5404 Research in International Contexts* to meet the 9-credit minimum requirement

Application Process:

-Fill out the graduate certificate application
--Obtain the necessary signatures; return the original to the Graduate Life Center and submit a copy to the Global Education Office along with the completed Global Education certificate form and your program of study
--Contact the certificate administrator to arrange for a day/time/location to make your presentation
--Before graduation, submit an abstract of your thesis, dissertation, or major paper to the Global Education Office
--Complete the application for conferral of degree or certificate and return to the Graduate Life Center

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Natural Resources
NATC

Address:
Virginia Tech Research Center - Arlington 900 N. Glebe Road
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• GCNR Information

Web Resource(s):
• Website

Phone Number(s):
• *Center for Leadership in Global Sustainability:* 571/858-3338

Graduate Certificate in Natural Resources (GCNR) Overview

The **Graduate Certificate in Natural Resources (GCNR)** is a good option for professionals seeking credentials in environmental and natural resource management, graduate students in another discipline looking to formalize their knowledge and training in an environmental field, and potential MNR degree students interested in exploring the coursework and earning graduate credits before making a decision.

All courses for this 12 credit hour program are offered online to accommodate busy schedules. Our catalog of courses allows you to focus on your interests, from biodiversity to climate change, green infrastructure to urban ecology, and more.

For more information, click here to access our website.

How to Apply:
Fill out the online application for participation in the certificate program.

Natural Resources NATC

Address:
Virginia Tech Research Center - Arlington 900 N. Glebe Road
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• GCNR Information

Web Resource(s):
• Website

Phone Number(s):
• *Center for Leadership in Global Sustainability:* 571/858-3338

Certificate Overview | Admissions & Course Requirements

GCNR Admission Requirements

Students can apply for the GCNR as a degree-seeking student, non-degree-seeking (Commonwealth Campus) student, or visiting student. If you are not currently a VT student or a graduate student at another institution (visiting student status), you must apply for graduate admission through the Virginia Tech Graduate School as a Graduate Certificate status applicant. Requirements for admission include:

- Completed undergraduate degree
- 2-3 Letters of Recommendation
- Current resume/CV
- Personal goal statement
- Completed application
- No GRE required; TOEFL may be required for international students

GCNR Requirements

The GCNR can be completed in a single academic term or over the course of several semesters. Many GCNR students go on to complete a Master of Natural Resources degree. All NR courses are offered online for three credits unless otherwise noted.

Required coursework:

- NR 5724 Conservation Ecology - 3 hours
- NR Elective - 3 hours
- NR Elective - 3 hours
- NR Elective - 3 hours

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Naval Engineering
NAVC

Address:
Aerospace and Ocean Engineering (MC 0203) Randolph Hall, RM 215 Virginia Tech 460 Old Turner St.
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Graduate Program Coordinator

Web Resource(s):
• Website

Phone Number(s):
• *General Assistance:* 540/231-3579

Certificate Overview | Admissions & Course Requirements

Certificate Overview

Naval Engineering is defined as a field of study and expertise that includes all engineering and sciences as applied in the research, development, design, construction, operation, maintenance, and logistic support of surface and subsurface ships, craft, aircraft, and vehicles (manned and autonomous) used by the Navy for the nation's defense. It is inherently multidisciplinary involving all departments from the College of Engineering and departments from other colleges as well. This certificate program enables graduate students throughout the College of Engineering to better prepare for this critical profession. It is open to all graduate students in the College of Engineering including Distance Learning students.

How to Apply:
Fill out the online application for participation in the certificate program.

Naval Engineering
NAVC

Address:
Aerospace and Ocean Engineering (MC 0203) Randolph Hall, RM 215 Virginia Tech 460 Old Turner St.
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Graduate Program Coordinator

Web Resource(s):
• Website

Phone Number(s):
• *General Assistance:* 540/231-3579

Admission Requirements

Students must have:

- Registered no later than the last day to add courses for the semester in which they complete the last courses for the certificate,
- Submitted the application for the certificate to the Graduate School, which has been signed by one of the faculty members on the Graduate Certificate in Naval Engineering Oversight Committee,
- Attained a minimum GPA of 3.0 on a 4.0 scale in the designated courses, and
- Submitted the application for certificate conferral to the Graduate School.

Course Requirements

Required:

AOE	**5324**	**Principles of Naval Engineering**
AOE	**5314**	**Marine and Naval Systems Engineering Design**

Complete additional 6 units from the following list with a minimum grade of B- or better:

AOE	**5304**	**Advanced Naval Architecture**
AOE	**5315&5316**	**Naval Ship Design**
AOE	**5074**	**Advanced Ship Structural Analysis**
AOE	**4344**	**Dynamics of High-Speed Marine Craft**
AOE	**5984G**	**Principles of Submarine Design**

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Nonprofit and Nongovernmental Organization Management NNMC

Address:
Virginia Tech, SPIA Richmond Campus 2810 N. Parham Road, Suite 205
Richmond, Virginia 23294

Contact this Certificate

Email Contact(s):
• Leisha LaRiviere, Director
• Jennifer Quam-Howell. Coordinator

Web Resource(s):
• VTO Website
• SPIA Website

Phone Number(s):
• *Leisha LaRiviere:* 804/920-6084
• *Jennifer Quam-Howell:* 540/598-1374

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The School of Public and International Affairs' (SPIA) graduate certificate in Nonprofit and Nongovernmental Organization Management (NNGOM) serves graduate students and working professionals in the public sector. Our students live, work, and study across the globe - allowing for inquiry and understanding of the various contexts in which nonprofits and NGOs operate. Certificate course professors are both academics and practitioners in nonprofits and government. Learning, research, analysis, and conversation occur at the crosswalk of theory and practice. Classes are highly interactive, typically project-based, and often include guest lectures from luminaries in the field.

The SPIA graduate certificate offers a streamlined curriculum enabling students to complete the course in one academic year. All courses are offered online. Learn more about the certificates on the SPIA website at https://spia.vt.edu/academics/certificates/npm.html

How to Apply:
Fill out the online application for participation in the certificate program.

Nonprofit and Nongovernmental Organization Management NNMC

Address:
Virginia Tech, SPIA Richmond Campus 2810 N. Parham Road, Suite 205
Richmond, Virginia 23294

Contact this Certificate

Email Contact(s):
• Leisha LaRiviere, Director
• Jennifer Quam-Howell. Coordinator

Web Resource(s):
• VTO Website
• SPIA Website

Phone Number(s):
• *Leisha LaRiviere:* 804/920-6084
• *Jennifer Quam-Howell:* 540/598-1374

Admission Requirements

Admission and award requirements for the Nonprofit and Nongovernmental Organization Management certificate program are equivalent to the requirements for the Graduate School and the participating SPIA programs.

For persons not already enrolled in a Virginia Tech master's or doctoral program:

- Bachelor's Degree
- Graduate School application (Graduate Certificate in Nonprofit and NGO Management)
- Application Fee (see Graduate School for amount)
- Transcripts - undergraduate and other graduate degrees, if applicable.
- GRE scores are not required.
- Curriculum Vitae
- Letter describing your substantive interests and possible area of specialization
- International Students - also include TOEFL examination scores

For master's and doctoral students:

- be accepted as a graduate student in an established academic department
- have at least one faculty member from the School with experience in NPOs/NGOs on your graduate committee
- have your application signed by your major professor
- provide evidence of how you will integrate this certificate program into your overall plan of study

Certificate Award

In order to earn the graduate certificate in Nonprofit and Nongovernmental Organization Management, students must complete all certificate courses with a grade of "C-" or better and maintain a minimum GPA of 3.0 across the certificate courses.

Course Requirements

All students must complete SPIA 5574 and at least three of the other five courses listed below for a total of 12 hours of graduate coursework.

Required:

- **SPIA 5574 - Nonprofit Organization and Management** - explores internal management for nonprofit and nongovernmental organization managers with emphasis on unique cultural, social, political, and economic challenges facing nonprofit managers. Key management knowledge, processes, and systems skills for managers in nonprofit organizations and NGOs and the role of internal collaboration.

Select three courses from this list:

- **SPIA 5514: Nongovernmental Organizations in International Development -** discusses the roles of Nongovernmental Organizations (NGO) in international development. NGO interactions with local governments, community organizations, international governmental organizations, and private businesses.

Tensions and collaborations between NGOs and other development actors.

- **SPIA 5524: Nonprofit Accountability and Evaluation -** examines the societal role of the nonprofit sector. Why nonprofit organizations are held accountable, to whom they are accountable, and how organizations can satisfy accountability demands. Evaluation tools for accountability.
- **SPIA 5534: Nonprofit Organization Leadership -** focuses on methods of devising and implementing leadership strategies in the complex economic, cultural, social, and political contexts in which nonprofit and nongovernmental organizations operate. Theories, models, and tools for success, focusing on leadership accountability, ethos, and performance.
- **SPIA 5544: Public and Nonprofit Financial Management -** centers on the role of finance in the management of complex public, nonprofit, and nongovernmental organizations. Functions of financial management, including planning and budgeting, reporting, resource acquisition, and internal controls in the nonprofit context.
- **SPIA 5564: Nonprofit and Nongovernmental Law and Ethics -** explores the legal, ethical, and normative systems affecting nonprofit and nongovernmental organizations, both domestically and internationally. Examines the historical foundations of legal regulation and professional ethics within the sector and how these systems contribute to the administration and governance of nonprofit and nongovernmental organizations. Also surveys current theories of nonprofit/ nongovernmental organization regulation as well as major legal and ethical issues confronting the sector.
- **SPIA 5614: Building Participation and Engagement in Volunteer-Based Organizations -** develops an understanding and habits of practice to define and evaluate effective participation and engagement in nonprofit volunteer organizations. Roles of enhanced autonomy, decentralization, democracy, and inclusive decision-making in attracting and retaining volunteers are discussed. Strategies for managing large groups of volunteers and deepening volunteer commitment to engagement for purposes of the organization mission are spotlighted in course lecture, assignments, and conversations with practitioners.

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Nuclear Engineering
NEC

Address:
Department of Mechanical Engineering Nuclear Engineering Program 455 Goodwin Hall (MC 0238) 635 Prices Fork Road
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Alireza Haghighat
• Cathy Hill
• Allison Jones

Web Resource(s):
• Mechanical Engineering
• Nuclear Engineering

Phone Number(s):
• *Cathy Hill:*
540/231-7460
• *Allison Jones:*
703/538-3790

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Nuclear Engineering Graduate Certificate provides a purposeful, cohesive set of technical electives in nuclear engineering and facilitates networking among faculty, students, and employers in nuclear engineering applications. Coursework is available online, hybrid on the DC-area campus, and in-person on the Blacksburg campus. The certificate is useful in transitioning from a non-nuclear engineering-related job to a nuclear engineering-related job, and the credit hours earned may be applied to a graduate degree in Nuclear Engineering at VT.

The Nuclear Engineering Graduate Certificate provides experience to students who do not have a nuclear engineering degree but are seeking engineering positions in the nuclear industry. The certificate provides a solid foundation in nuclear reactor physics, with additional specialization in reactor physics, nuclear fuel cycle, radiation measurements, reactor thermal hydraulics, nuclear materials, or nuclear power plant operations. The certificate requires completion of 9 credit hours of graduate course work.

How to Apply:
Fill out the online application for participation in the certificate program.

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Nuclear Engineering
NEC

Address:
Department of Mechanical Engineering Nuclear Engineering Program 455 Goodwin Hall (MC 0238) 635 Prices Fork Road
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Alireza Haghighat
• Cathy Hill
• Allison Jones

Web Resource(s):
• Mechanical Engineering
• Nuclear Engineering

Phone Number(s):
• *Cathy Hill:*
540/231-7460
• *Allison Jones:*
703/538-3790

Admission Requirements

Applicants that are not currently enrolled at VT may apply at https://applyto.graduateschool.vt.edu/. Please use this form to create your proposed plan of study.

Current VT students may submit this application for the certificate to negrad@vt.edu.

Requirements:

- Undergraduate degree with a minimum 2.8 GPA (4.0 scale)
- TOEFL or IELTS for applicants that need to demonstrate English language proficiency (see https://graduateschool.vt.edu/admissions/how-to-apply/testing-requirements.html for details)

Recommended:

- B.S. degree in an engineering or science-related discipline
- 3.2 or higher GPA on the most recent 60 course credit hours
- Understanding of the following mathematical concepts: trigonometry, exponentials, natural logarithms, derivatives, the chain rule for derivatives, integrals, vector operations, and some ordinary differential equations

No GRE test scores or recommendation letters are required for the certificate application.

Course Requirements

1. Complete a minimum of 9 credit-hours of nuclear engineering-related coursework through Virginia Tech – 3 credit-hours of required courses and 6 credit-hours of elective courses from the approved list below. The approved elective list will be updated each year. Only a maximum of 3 credit-hours total may be taken for NSEG 5974. Up to 6 credit-hours of NSEG 5984 may be taken if two different course titles are involved.

2. All courses must be taken for a letter grade with a grade of B- or better. Pass/Fail grades will only be permitted for the NSEG 5974 course. A final average GPA of 3.00 or better must be achieved in the 9 hours of coursework accepted for the certificate.

1. REQUIRED COURSE:

Course No. Title (Credit-hours)

NSEG 5114 Nuclear Engineering Fundamentals (3)*

* *Completion of NSEG 3145 & 3146 at the undergraduate level will satisfy completion of this NSEG 5114 required course. However, another course from the Elective list below must replace it such that the student completes 9 graduate course credits total.*

2. ELECTIVE COURSES (select two):

Course No. **Title (Credit-hours)**

NSEG 5104 Applied Mathematics for Nuclear Engineers (3)

NSEG 5124 Nuclear Reactor Analysis (3)

NSEG 5134 Monte Carlo Methods for Particle Transport (3)

NSEG 5204 Nuclear Fuel Cycle (3)

NSEG 5214 Nuclear Power Plant Operations & Systems (3)

NSEG 5284 Nuclear Nonproliferation, Safeguards and Security (3)

MSE 5384G Advanced Nuclear Materials (3)

NSEG 5424 Reactor Thermal Hydraulics (3)

NSEG 5504 Radiation Effects on Metals and Alloys (3)

NSEG 5514 Structural Materials Degradation in Nuclear Power Systems (3)

NSEG 5604 Radiation Detection & Shielding (3)

NSEG 5974 Independent Study (Nuclear Engineering) (3)**

NSEG 5984 Special Study (Nuclear Engineering) (3)**

NSEG 6124 Advanced Nuclear Reactor Analysis (3)

NSEG 6334 Nuclear Reactor Safety Analysis (3)

NSEG 6984 Advanced Special Study (Nuclear Engineering) (3)

*** A total of 3 hours maximum for NSEG 5974 or 6 hours maximum for NSEG 5984 (two different course titles) w/ approval of program coordinator*

Location

The Nuclear Engineering Program is located at:

Department of Mechanical Engineering (MC 0238)
455 Goodwin Hall
635 Prices Fork Road
Blacksburg, VA 24061

and

Virginia Tech
Northern Virginia Center
7054 Haycock Road
Falls Church, VA 22043

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Nuclear Science, Technology, and Policy
NTPC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Sonja Schmid

Web Resource(s):
• Department of Science, Technology, and Society
• Nuclear Engineering Program
• School of Public and International Affairs

Phone Number(s):
• *Office:*
703/538-8482

Certificate Overview | Admissions & Course Requirements

Overview

The Nuclear Science, Technology, and Policy Graduate Certificate integrates policy and management with nuclear science and technology to prepare students from diverse educational backgrounds for careers managing and leading nuclear policy organizations across a spectrum of activity in safety, security, safeguards, and non-proliferation. The Certificate courses offer fundamental knowledge of concepts in nuclear science and technology that are relevant to policy issues, and also provide an introduction to topics in safety, security, and nonproliferation, which occupy the bulk of government concerns with nuclear issues. Finally, the Certificate will allow students to interact with policymakers in the field through briefings, simulations, and exercises at the Certificate's Northern Virginia locations and institutions, agencies, and other partners in Washington, DC. Available Spring 2019.

How to Apply:
Fill out the online application for participation in the certificate program.

Nuclear Science, Technology, and Policy
NTPC

Address:
7054 Haycock Road
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Sonja Schmid

Web Resource(s):
• Department of Science, Technology, and Society
• Nuclear Engineering Program
• School of Public and International Affairs

Phone Number(s):
• *Office:* 703/538-8482

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Admission to the Graduate School and completing a Graduate Certificate Application are required for all students. For both degree-seeking and non-degree-seeking students, the Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better for admission to Certificate Status. Applicants with an undergraduate GPA < 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program. Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study. The faculty administering the Certificate will assist students with determining course selection.

Course Requirements

The total number of credit hours required is 12. The Certificate requires completing two dedicated ("core") courses: the anchor course, STS/SPIA/NSEG 5284, and a capstone course (offered as GRAD 5134 Interdisciplinary Research – this course will only count toward the Certificate when it is offered as the Nuclear Science and Technology Policy Certificate Capstone). In addition, each student selects one technical course, and one social sciences course ("electives"). Since some electives are offered under "advanced topics" course numbers, these courses can only count toward the certificate if they are offered on specific topics. We have provided a tentative list below ("related"); this list is not meant to be comprehensive. The certificate faculty will consider other related courses, existing and new ones, to count as electives toward the certificate. In all instances, the selection of elective courses needs to be approved by a student's advisor.

The core courses will be co-taught by faculty members from engineering/science and policy/STS. The two core courses explicitly target both technical and non-technical students.

The anchor course is designed to provide a broad overview of both technical and non-technical matters related to nuclear science, technology, and policy, and to introduce fundamental terms, categories, and processes, often in a hands-on manner.

The capstone course will include two main activities: 1) critical analysis of technical challenges and policy dilemmas in the nuclear fields; 2) engagement with specific case studies and current issues. For both activities, we will invite experts from various government and nonprofit organizations in the Washington DC Metro area to give seminars and to participate in the formation and evaluation of case studies. The students in the capstone will engage in a semester-long problem-based learning project that they will develop with their peers and instructors throughout the semester. They will apply the conceptual tools, theories, and methods learned in the other certificate courses, and present a final report to a relevant agency or decision-maker.

List of courses

Core Courses

STS/NSEG/SPIA 5284 (anchor course), Nuclear Nonproliferation, Safeguards, and Security. Technical essentials, policy analysis, theoretical perspectives of nuclear energy and nuclear nonproliferation. Fundamentals of the nuclear fuel cycle, management of international safeguards, threat of nuclear terrorism, and challenges for global nuclear industry. Pre: Graduate standing (3H, 3C).

GRAD 5134 Interdisciplinary Research. Taught as the Capstone in Nuclear Science, Technology, and Policy. Seminar-style series of lectures, discussions, and active-learning exercises, with one semester-long problem-based learning assignment (depending on student numbers in two or more teams). This allows students to apply the tools acquired in the anchor course in interdisciplinary teams, with real-world relevance. The results of the project(s) will be presented to one or more stakeholders outside the university. Outside speakers will be recruited from industry, government agencies, national labs, community organizations, etc. Pre: Graduate standing (3H, 3C)

Electives, Technical Courses

NSEG 5114, Nuclear Engineering Fundamentals. A foundations course in nuclear engineering to prepare graduate students for all subsequent graduate work in the field of nuclear engineering. Topics include neutron physics, reactor theory and kinetics, basic reactor design and operation, and overall power plant operation. Pre: Graduate standing (3H, 3C)

NSEG 5124, Nuclear Reactor Analysis. Nuclear reactions and fission process. The fission chain reaction. Neutron diffusion and moderation. Introduction to reactor theory. One-speed diffusion model of a nuclear reactor. Neutron slowing and multigroup diffusion theory. Nuclear reactor kinetics. Introduction to reactor core physics design. Reactor physics analysis. Pre: 5114 (3H, 3C)

NSEG 5134, Applied Monte Carlo Methods for Particle Transport. This is a general course on the Monte Carlo Methods which uses fundamental particle transport concepts to demonstrate various methodologies and examine associated issues. The topics covered include: random processes; random number generation techniques and testing; fundamental formulation of Monte Carlo (FFMC); various sampling procedures; fundamentals of probability and statistics as needed for MC simulations; non-analog or variance reduction techniques; various tallying procedures; representation of physical models based on combinatorial geometry; solving integral formulations via MC; importance sampling and the use of importance function; use of MC for eigenvalue problems; MC methods in parallel and vector environments; and use of MC for simulation of various real-life problems. Pre: Graduate standing (3H, 3C)

NSEG 5204, Nuclear Fuel Cycle. Uranium nuclear fuel cycle: mining, conversion, enrichment, fuel manufacturing, in-core fuel management and refueling, spent fuel storage, reprocessing/recycling and final disposition as waste in a geologic repository. Introduction to nuclear safeguards and nonproliferation as applied to each step of fuel cycle. Pre: Graduate standing (3H, 3C)

NSEG 5214, Nuclear Power Plant Systems and Operations. Nuclear reactor startup and shutdown, reactivity control, casualty procedures, refueling, initial startup of new plants, standards and codes, ethics and integrity. Pre: 5114 (3H, 3C)

MSE 5384G, Advanced Nuclear Materials. Introduction to materials for nuclear applications with emphasis on fission reactors. Fundamental radiation effects on materials; material properties relevant to structural, moderator, reflector, blanket, coolant, control shielding and safety systems; processes such as nuclear fuel cycles, fuel enrichment and reprocessing, and related structural systems. Pre: Graduate standing (3H, 3C)

NSEG 5424, Reactor Thermal Hydraulics. Fundamental processes of heat generation and transport in nuclear reactors. Heat generation by fission and radiation interactions; spatial distribution of heat generation; heat transport by conduction and convection. Effects of boiling and critical heat flux. Fundamentals of reactor thermal and hydraulic design. Pre: 5114 (3H, 3C)

NSEG 5604, Radiation Detection and Shielding. Radioactive decay, interaction of charged particles and photons with matter, methods of radiation detection and radiation dosimetry, counting statistics, external radiation protection using time, distance and shielding. Pre: Graduate standing (3H, 3C)

NSEG 6124, Advanced Nuclear Reactor Analysis. Neutron transport theory: derivation and solution techniques of the neutron transport equation. Analytical solution methods; discrete ordinates method; spherical harmonics method. Integral form of the transport equation. Monte Carlo method. Introduction to neutron transport computer codes and their application in reactor core and shielding design. Pre: 5124 (3H, 3C)

NSEG 6334, Nuclear Reactor Safety Analysis. Hazards of nuclear reactors; analysis of hypothetical design basis accidents; engineered safeguards and safety design principles; nuclear criticality safety; reactor containment; reactor safety codes; and probabilistic risk assessment. Pre: 5114 (3H, 3C)

Electives, Social Sciences and Policy Courses

PAPA 5254, Homeland Security and the Terrorist Threat. A multidisciplinary introduction to the theory, strategy, decision-making, and doctrine of Homeland Security as practiced in the U.S. Describes the threat, nature of current global conflicts in which the U.S. is engaged, America's foreign and domestic policy responses to 9/11, and strategic and operational homeland security functions. Designed to promote subject matter understanding, simplification of issues, and consensus decision-making. Pre: Graduate standing (3H, 3C)

PAPA 5354, Homeland Security Response and Recovery. Multi-disciplinary policy course focused on emergency response and recovery following catastrophic manmade and natural disasters in the U.S. Emphasis on strategic and operational decision making; response models and strategies; the preparation, response and recovery roles and responsibilities of federal, state, and local jurisdictions; and federal policy alternatives to address the complex resource challenges of multi-jurisdictional response planning and operations execution. Designed to promote subject matter understanding, simplification of issues, and consensus decision-making. Pre: Graduate standing (3H, 3C)

GIA 5514 (PSCI 5514), Global Security. This course examines the changing nature of global security. It offers an introduction to the meaning of global security at a time of rapid change in international affairs. It examines the traditional sources of insecurity in the international system, the rising concerns and threats to global security from ethnic conflicts and failing states, and the emerging new security agenda arising from challenges to global stability including threats arising from poverty, discrimination, environmental degradation and the lack of human rights. This course seeks to understand the root causes of insecurity and the various challenges to international stability in the contemporary international system. Discussions include the policy implications of these security challenges, the mechanisms developed by the international community, and the response of states and other actors in the international system to meet these challenges today. Pre: GIA 5444 or PSCI 5444 or UAP 5264 (3H, 3C)

GIA 5664, Energy and Environmental Security (new course, under review). Assesses how energy and natural resources affect human conflict, security, and risk. Considers theories of scarcity and human ecology pertaining to causes of wars. Examines case studies of different natural resources to identify drivers of risk, resilience, and sustainability. Pre: Graduate standing (3H, 3C).

STS/SPIA 6554 Energy Policy: Historical and Contemporary Issues. Social-scientific perspectives in energy policy. National and international topics and controversies such as fossil fuel resources, climate change, energy security, and the debate over nuclear power. Comparison of international perspectives. Challenges involved with management and regulation of large technological systems, the politics of expertise at the intersection of global climate change and energy security, and the changing character of our global energy infrastructure. Pre: Graduate standing (3H, 3C).

STS/SPIA 6564, Risk in Contemporary Culture. Examines the phenomenon of risk from a variety of qualitative perspectives. Considers what constitutes a risk, and who decides what risks to take. Critically addresses notions of safety, reliability, and probability underlying risk assessment and risk management. Focuses on the role of expertise, trust, and communication in risk regulation. Discusses which democratic policy instruments facilitate stable, consensual decisions in contemporary societies. Pre: Graduate standing (3H, 3C).

PSCI 5464 (ASPT 5464), Critical Security Studies. Provides an overview of the critical study of security in world politics. Introduces alternative conceptualizations of security to the military-focused, state-centric security/strategic studies. Considers constructivist, post-structuralist and critical theoretic attempts to conceptualize the nature of security. Compares and contrasts these approaches with widely-accepted understandings of security in light of key debates in contemporary security studies. Pre: PSCI 5444 or GIA 5444 (3H, 3C)

PSCI 5474 (GIA 5474), Global Governance. Examination of the norms, institutions and practices developed by the international community to address systemic global governance problems: genocide, failed states, transnational corruption, displaced persons, AIDS, poverty. Role of United States in World community examined. Power of international organizations versus states. Capacity problems of both. Future of United Nations and global governance considered. Pre: Graduate Standing. (3H, 3C)

PSCI 5514 (GIA 5514) Global Security. Security examined as an essentially contested concept. Traditional national security and emergent global security discourses and agendas explained. Security institutions and organizations analyzed. Questions of power, identity and representation examined as factors delimiting security conceptions, practices and agendas. Pre: Graduate Standing. GIA 5444 or UAP 5264 or PSCI 5444 (3H, 3C)

PSCI 5524, U.S. Foreign Policy After September 11. Course offers a historical and analytical evaluation of U.S. foreign policy after this epochal change especially with regard to the war on terror, geopolitics in the Middle East, and relations with new global powers after the end of the Cold War. Pre: PSCI 5484 (3H, 3C)

Related Courses (course can count toward the Certificate only when taught on the specific topic listed after the colon)

PAPA 6254, Advanced Topics in Public Policy: Critical Infrastructure Protection and Resiliency. An introduction to the policy, strategy and practical application of critical infrastructure protection and resiliency from an all-hazards perspective. Describes the strategic context presented by the 21st century risk environment, as well as the challenges and opportunities associated with infrastructure -related public-private partnerships, information-sharing, risk analysis and prioritization, risk mitigation, performance metrics, and incident management. Students will be exposed to complex intergovernmental and public-private sector policymaking, operational planning and crisis management. Designed to promote subject matter understanding, critical analysis of issues and insight into senior leader decision making.

Includes a practical examination of stakeholder interaction and key subject matter areas through an interactive tabletop exercise and research paper assignment. Pre: Graduate standing (3H, 3C).

PAPA 6264, Advanced Topics in Policy Systems Management: Homeland Security and Prevention. Consideration of the critical integration of national security and homeland security policies and operational activities at the federal, state, and local levels to create management systems that function effectively in complex environments. This course examines the relationship between national security policies that manifest themselves in the international arena and homeland security policies that focus on U.S. domestic issues. Includes advanced study of information sharing, critical infrastructure, law enforcement, transportation systems, borders, and response and recovery operations. Also investigates the possibilities and limits for prevention and mitigation activities at all levels of government. Pre: Graduate standing (3H, 3C).

PAPA/STS 6664, Advanced Topics in Science and Technology Policy: Complexity, Emerging Policy, Doctrine and Strategy. Variable topics in science and technology policy. Includes advanced study of science, technology, and economy; science, technology, and power; strategies for research and development policy, public and private sector; transfer of technology; technological forecasting; government regulation and responses; science policy assumptions and challenges, specialist knowledge and expertise; state and academic knowledge production; issues of race, class, gender, and national identity in policy work. Pre: Graduate standing (3H, 3C).

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Organizational Communication Management
OCMC

Address:
113 Shanks Hall Mail Code 0311
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Cayce Myers

Web Resource(s):
• Program webpage

Phone Number(s):
• *Cayce Myers:*
540/231-7165

Certificate Overview | Admissions & Course Requirements

Organizational Communication Management Overview

- - - - -

How to Apply:
Fill out the online application for participation in the certificate program.

Organizational Communication Management
OCMC

Address:
113 Shanks Hall Mail Code 0311
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Cayce Myers

Web Resource(s):
• Program webpage

Phone Number(s):
• *Cayce Myers:*
540/231-7165

Certificate Overview | Admissions & Course Requirements

Organizational Communication Management Admission Requirements

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Organizational Communication Management Course Requirements

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Politics and Policy Studies of Science and Technology
PPSC

Address:
___121 Lane Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Carol Sue Slusser

Web Resource(s):
• Website

Phone Number(s):
• *Graduate and Undergraduate Coordinator:*
540/231-0719

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The graduate certificate program in Politics and Policy Studies of Science and Technology (STS) targets three audiences: graduate students in other programs at Virginia Tech who would like to demonstrate additional competence in the politics and policies of STS, graduate students in contributing departments who would like to demonstrate special competence in the politics and policies of STS in their home discipline, and non-degree-seeking students who desire special competence in the politics and policies of STS for career advancement. In addition, mid-career professionals pursue this certificate if they are not particularly interested in another degree, however, they would like to be able to point to the completion of some shorter course of study. Students in this certificate program will critically assess science and technology policy. Students will be exposed to issues in bioethics in public policy, information technology, and politics.

How to Apply:
Fill out the online application for participation in the certificate program.

Politics and Policy Studies of Science and Technology
PPSC

Address:
___121 Lane Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Carol Sue Slusser

Web Resource(s):
• Website

Phone Number(s):
• *Graduate and Undergraduate Coordinator:*
540/231-0719

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Graduate students accepted in any other graduate program at Virginia Tech would be admitted to the Politics and Policy Studies of Science and Technology graduate certificate program on the basis of their acceptance to their home department.

Recommendations for admission to the certificate program for non-degree-seeking students would be made by the STS Graduate Admissions Committee, based on transcripts, a writing sample, a statement of purpose, and the minimal requirements specified in the Graduate Catalogue for admission to the Graduate School. (These admissions criteria differ from our regular degree admissions in that they require neither the GRE nor letters of recommendation).

Course Requirements

Number of Credit Hours: 12 credit hours. Only 6 cr can be double-counted for this certificate and a graduate degree. Transfer credits are not permitted.

Required Courses (6 credit hours):

STS/SOC 5105: Social Studies of Science and Technology I

STS/PAPA 5614 Introduction to Science and Technology Policy

Restrictive Elective (6 credit hours):

STS 5424: Topics in Science and Technology Studies

STS 5444: Issues in Bioethics

STS/PAPA 6664: Advanced Topics in Science and Technology Policy

PSCI/GIA 5354: Public Policy Analysis

PSCI/GIA 5214: Contemporary Political Theory

SPIA/GIA 5454: Advanced Topics in Information Technology and Public Policy

SPIA/GIA 5555: Culture, Politics, and Society in a Networked Environment

UAP 5564: Information Technology, Society, and Public Policy

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Problem Solving for Leading Change
PSLC

Address:
2270 Litton Reaves Hall (0343)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Curtis Friedel

Web Resource(s):
• Problem Solving for Leading Change Certificate

Phone Number(s):
• *Curtis Friedel:* 540/231-8177

Certificate Overview | Admissions & Course Requirements

Problem Solving for Leading Change

The purpose of this certificate is to examine how one's problem-solving style may influence how one solves problems, works in a team, leads change efforts, and acts as an agent of change in society. Solving complex problems and leading change can be a convoluted non-linear process and with many variables to consider. However, one key and often ignored variable is problem-solving style, which is how one prefers to solve problems. Problem-solving style indicates if a person is inherently more adaptive (making things better) or more innovative (making things different) when solving problems; which is independent of intelligence, learned skills, motive, ethnicity, culture, values, and situation. Kirton's Adaption-Innovation theory is a common theme throughout the coursework, which provides explanation to how more adaptive and more innovative individuals may work together to lead change. Because we are all problem solvers, we are all agents of change, and all can choose to lead.

Program Outcomes

This graduate certificate will complement Virginia Tech graduate students' academic education through the following learning outcomes:

- Evaluate the research literature regarding problem solving, problem-solving style, teamwork, and social change in light of contemporary theories.
- Examine the stages of problem solving, group development, and change management as they relate to each other.
- Propose practical solutions to identified societal problems by first identifying existing systems as an agent of change.

How to Apply:
Fill out the online application for participation in the certificate program.

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Problem Solving for Leading Change
PSLC

Address:
2270 Litton Reaves Hall (0343)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Curtis Friedel

Web Resource(s):
• Problem Solving for Leading Change Certificate

Phone Number(s):
• *Curtis Friedel:* 540/231-8177

Admission Requirements

Admission to the Graduate School and completing a Graduate Certificate Application are required for all students. For both degree-seeking and non-degree-seeking students, the Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better for admission to Certificate Status. Applicants with an undergraduate GPA < 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program. Up to 6 Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study.

Course Requirements

Course will be offered within a calendar year so that students may complete the Graduate Certificate in Problem Solving in three academic terms. For example:

- Fall - LDRS 5534: Cognition, Problem Solving, and Preferences for Change
- Fall - LDRS 5544: Leading Teams through Change
- Spring - LDRS 5554: Leading Social Change
- Summer or Fall - LDRS 5904: Project and Report

Information for Non-Degree Seeking Students

New students who are visiting graduate students, not seeking a degree, or associated with Commonwealth Campus, are asked to notify Dr. Curtis Friedel at cfriedel@vt.edu, after having applied to the Graduate School so that applications may be reviewed promptly.

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Public Health
PHLC

Address:
205 Duck Pond Drive (0442)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Public Health Program

Web Resource(s):
• Graduate Certificate in Public Health

Phone Number(s):
• *(540) 231-3945:* 540/231-3945

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Public Health

The Graduate Certificate in Public Health is a 16 credit online and/or in person program that includes the core courses in our Master of Public Health (MPH) degree program. The Graduate Certificate in Public Health is helpful to non-degree seeking students who have completed an undergraduate degree in a related discipline and want to demonstrate content competence in public health. The certificate is also helpful to current graduate students at Virginia Tech from another discipline that want to gain essential public health knowledge to complement their other disciplinary area.

How to Apply:
Fill out the online application for participation in the certificate program.

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Public Health
PHLC

Address:
205 Duck Pond Drive (0442)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Public Health Program

Web Resource(s):
• Graduate Certificate in Public Health

Phone Number(s):
• *(540) 231-3945:* 540/231-3945

Graduate Certificate in Public Health Admission Requirements

For individuals currently pursuing a Virginia Tech graduate degree:

- Students pursuing a degree and a certificate simultaneously are classified within their degree program. Academic background meets the requirements of the admitting academic unit.
- Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study.

For individuals not currently pursuing a Virginia Tech graduate degree:

- Undergraduate degree from an accredited college or university
- GPA of 3.0 or above for the last 60 hours/credits of the undergraduate degree
- Prospective students from countries where the native language is not English: TOEFL score of 80

How to apply:

If you are a current Virginia Tech graduate student, complete the Graduate Certificate Application form here.

- The form should be completed by the student and then submitted to Becky Jones (bjones57@vt.edu) for signatures and processing.

If you are not currently working towards a graduate degree at Virginia Tech, please apply to the certificate program using the directions below:

- Apply online here.
- Required application materials include:
  - Resume or CV
  - Personal statement, 1-2 pages
  - Transcripts

Graduate Certificate in Public Health Course Requirements

Public Health Graduate Certificate course requirements (courses can be completed in person or online):

- PHS 5004 Foundations of Public Health (1 credit)
- PHS 5025 Epidemiology and Quantitative Methods in Public Health I (3 credits)
- PHS 5026 Epidemiology and Quantitative Methods in Public Health II (3 credits)
- PHS 5044 Public Health Policy and Administration (3 credits)
- PHS 5034 Health Behavior and Health Education (3 credits)
- PHS 5014 Environmental Health (3 credits)

If you need help designing a course sequencing that works best for you, please contact the program (phs@vt.edu).

Graduate Certificate in Public Health Conferral

When you have completed all Public Health Graduate Certificate courses, please complete the Degree or Certificate Conferral Request found here.

- The form should be completed by the student and then submitted to the Graduate School.

Transitioning to the Master of Public Health

Students that have completed the Graduate Certificate in Public Health have the option to transfer all of the completed certificate courses into our Master of Public Health (MPH) degree program. Please contact the program (phs@vt.edu) if you are interested in exploring this option.

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Graduate Catalog
2022-2023

Policies, Procedures, Academic Programs

Public History
PHC

Address:
Department of History, 431 Major Williams Hall, 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• LaDale Winling
• Matthew Heaton

Web Resource(s):

Phone Number(s):
• *Department of History:*
540/231-5331

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Graduate Certificate in Public History enables students to develop the analytical and interpretive tools of a graduate history education and to apply them in public practice. The certificate is earned with twelve credit hours. Six certificate credits can be used also to fulfill requirements for the Master's degree in History.

How to Apply:
Fill out the online application for participation in the certificate program.

Public History
PHC

Address:
Department of History, 431 Major Williams Hall, 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• LaDale Winling
• Matthew Heaton

Web Resource(s):

Phone Number(s):
• *Department of History:* 540/231-5331

Admission Requirements

Students applying to the MA program in History should indicate an interest in public history and the Certificate in Public History as part of their application statement.

Students already admitted to graduate programs at Virginia Tech with an interest in pursuing the Graduate Certificate should send a letter of intent (no more than 500 words) addressed to the Graduate Committee, Department of History. In the letter applicants should explain their interest in public history and describe any experiences in a public history setting.

Admission to the certificate program requires good standing in a graduate program at Virginia Tech.

Course Requirements

The Graduate Certificate requires 12 credits of graduate level coursework in History, nine of which must be chosen from the department's public history course offerings and three from graduate level courses in history. The 12 credits for the Graduate Certificate are distributed as follows:

HIST 5424: Public History (3 credits)
HIST 5964: Field Study/Practicum (Internship) (3 credits)

At least one of the following public history courses:
HIST 5434: Digital History Methods
HIST 5444: Oral History
HIST 5454: Topics in Public History

In addition, all students, including those not pursuing an MA in history, must complete a graduate level history course from the following list:
HIST 5114: U.S. History to 1877
HIST 5124: U.S. History since 1877
HIST 5214/ASPT 5214: Topics in Global History
HIST 5246: Readings in Latin American History
HIST 5504: Modern European History

The Graduate Certificate in Public History requires 12 credits of graduate coursework in History, 9 of which must be chosen from the department's public history offerings. These include the public history graduate class and an additional offering on a public history methodology or topic. Additionally, students will complete a 3-credit, 120-hour internship with a historic site, museum, or institution of the student's choice, usually during the summer after the first year. For more information, see the requirements for the certificate on the history department's website, or contact the Director of Public History at JessicaTaylor@vt.edu.

Public and Nonprofit Financial Management
PNPC

Address:
VT SPIA Richmond Campus 2810 N. Parham Road, Suite 205
Richmond, Virginia 23294

Contact this Certificate

Email Contact(s):
• Leisha LaRiviere, Director
• Jennifer Quam-Howell, Coordinatorator

Web Resource(s):
• VT SPIA

Phone Number(s):
• *Leisha LaRiviere:* 804/920-6084
• *Jennifer Quam-Howell:* 540/598-1374

Certificate Overview

Money. Expending, managing, growing, controlling, and making decisions about public and nonprofit finance are the responsibilities of today's public leaders and managers. No longer the solitary purview of accountants and other fiscal specialists, government and nonprofit leaders at all levels need to understand the levers of finance and when to pull them. The graduate certificate in Public and Non-profit Financial Management is designed to develop students' and working professionals' understanding of critical paths that examine citizen and donor dollar uses and protections, as well as concepts and strategic practices that merge larger economic issues with organization needs and goals. The certificate integrates financial management perspectives from the federal, state, local and nonprofit and nongovernmental organizations while synthesizing the concept of financial resiliency for organizations.

The current, volatile financial landscape requires financial competencies for all employees. Financial mastery is increasingly a pre-requisite for high-level positions in public service organizations. Available across the Commonwealth through virtual classroom technology, the Public and Non-Profit Financial Management certificate is designed for full-time students as well as part-time and working professional students. The shared format allows for a productive mix of viewpoints and experience levels, which enhances learning for all students. Students earning this certificate are prepared for a public service labor market that demands financial literacy, whether they are pre-career students seeking first jobs or working professionals looking to broaden their horizons and for opportunities for advancement.

Students are exposed to a full spectrum of financial management issues through both theoretical instruction and case studies. Lectures from luminaries in the field and current practitioners provide exciting opportunities for learning and networking, and a deeper understanding of what fiscal issues really "look like" in practice. Classroom discussion, group work, and individual assignments simulate real work scenarios and prepare students for real life application. Several classes include governments as "real time" clients.

The School of Public and International Affairs' (SPIA) graduate certificate in Public and Nonprofit Financial Management (PNPFM) offers a streamlined curriculum enabling students to complete the certificate in one academic year. All courses are offered online. **Visit the SPIA PNPFM website HERE.**

How to Apply:
Fill out the online application for participation in the certificate program.

Public and Nonprofit Financial Management
PNPC

Address:
VT SPIA Richmond Campus 2810 N. Parham Road, Suite 205
Richmond, Virginia 23294

Contact this Certificate

Email Contact(s):
• Leisha LaRiviere, Director
• Jennifer Quam-Howell, Coordinatorator

Web Resource(s):
• VT SPIA

Phone Number(s):
• *Leisha LaRiviere:* 804/920-6084
• *Jennifer Quam-Howell:* 540/598-1374

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Admission and award requirements for the graduate certificate in Public and Nonprofit Financial Management (PNPFM) certificate program are equivalent to the requirements for the Graduate School and the participating SPIA programs. Degree and non-degree candidates must submit the Application for Graduate Certificate form to the Graduate School at Apply Here!

For persons not already enrolled in a Virginia Tech master's or doctoral program:

- Bachelor's Degree
- Graduate School application - Graduate Certificate in Public and Nonprofit Financial Management (PNPFM)
- Application Fee (see Graduate School for amount)
- Transcripts - undergraduate and other graduate degrees, if applicable
- GRE scores are not required
- Curriculum Vitae
- Letter describing your substantive interests and possible area of specialization
- International Students - also include TOEFL examination scores

For master's and doctoral students:

- be accepted as a graduate student in an established academic department
- have at least one faculty member from the School with experience in NPOs/NGOs on your graduate committee
- have your application signed by your major professor
- provide evidence of how you will integrate this certificate program into your overall plan of study

Certificate Award

Earning the graduate certificate in Public and Nonprofit Financial Management, requires that students must complete all certificate courses with a grade of "C-" or better and maintain a minimum GPA of 3.0 across the certificate courses.

Course Requirements

All students must complete SPIA 5544 and at least three of the other five courses listed below for a total of 12 hours of graduate coursework.

Required:

SPIA 5544 - Public and Nonprofit Financial Management: Surveys the role of finance in the management of complex public, nonprofit, and nongovernmental organizations. Functions of financial management, including planning and budgeting, cash and debt management, accounting and reporting, resource acquisition, internal controls and financial resiliency.

Select three courses from this list:

- **SPIA 5644 - Budget Performance Management & Outcomes for Public & Nonprofit Organizations:** Developing skills in budgeting, performance management, and outcome measurement for public and nonprofit organizations. Connections among Federal, state, local and nonprofit budgeting processes. Budgeting as strategic planning. Performance budgeting, benchmarking, and resiliency in the development of public and nonprofit organization budgets.

- **SPIA 5654 - Capital & Debt Financial Management for Public & Nonprofit Organizations:** Understanding concepts and practices in Capital budgeting, debt limits and debt policies. Connections among Federal, state, and local government capital budgeting. Debt issuance, internal controls, interest earnings and the role of financial institutions. Benchmarking techniques and best practices for the financial health and resiliency of public and nonprofit organizations.
- **SPIA 5674 - Financial Health of Public and Non-Profit Organizations Concepts:** Using tools and analytical techniques necessary to evaluate the financial condition, fiscal environments and overall financial health of governmental and nonprofit organizations. Resiliency and the impact of policy and management on the financial health of the organization.

- **PAPA 5694 – Asset Management for Public and Nonprofit Organizations**: Understanding asset management for governmental and nonprofit/nongovernmental entities. Focuses on the essentials of cash budgeting and cash management, investment of endowments and pension funds, and debt financing for governmental and nonprofit/non-governmental organizations.

- **PAPA 6314 - Public Budgeting Processes and Their Policy Implications**: Surveying the public budgeting processes of public organizations. The contrasting norms and behaviors of participants, their impacts on policy, and their implications for democracy are examined. Processes studied include the work of budgeteers, decision-making processes, control, and financial accounting, and intergovernmental interaction. (Note: this course is also a core requirement for the Master of Public Administration (MPA) degree at Virginia Tech).

Race and Social Policy
RSPC

Address:
564 McBryde Hall, 225 Stanger St
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wornie Reed

Web Resource(s):
• Website

Phone Number(s):
• *Wornie Reed:* 540/231-6107

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Race and Social Policy Certificate Program is a 12-hour concentration, providing an opportunity for Master's and Ph.D. level graduate students to develop understanding of issues of race, ethnicity and culture, especially as they relate to public policy. The certificate program's practical value includes the enhancement of knowledge and analytical abilities regarding the intersection of race, ethnicity and social policy issues. The certificate is a credential that is applicable to a wide range of careers, including law, secondary and higher education, human resources, criminal justice, health care, housing, and welfare. The overarching aim of the program is to provide a coherent, interdisciplinary grounding in race and social policy scholarship and to create an intellectual community among faculty and graduate students sharing similar scholarly interests.

How to Apply:
Fill out the online application for participation in the certificate program.

Race and Social Policy
RSPC

Address:
564 McBryde Hall, 225 Stanger St
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wornie Reed

Web Resource(s):
• Website

Phone Number(s):
• *Wornie Reed:*
540/231-6107

Admission Requirements

Graduate students accepted in any graduate program at Virginia Tech may be admitted to the Race and Social Policy certificate program. Decisions for admission to the certificate program for non-degree seeking students would be made by the Sociology Graduate Admissions Committee, based on transcripts, a writing sample, and a statement of purpose.

Course Requirements

RSP concentration students are required to complete AFST 5984: Survey of Race and Social Policy in the U.S. (3 credits), plus 9 additional credits in approved graduate-level (5000 and above) electives. In addition to the pre-approved courses listed below, other courses may be approved by the Director upon review of a course syllabus to ascertain that sufficient attention is given to issues of race and ethnicity in the respective courses. Students planning to take courses not included in the pre-approved list should consult the Director prior to enrolling to insure that the desired course will meet the criteria established.

RSP Concentration Courses

Course Name and Number	Credit Hours
A. Required Core Course	
AFST 5984, Special Study: Survey of Race and Social Policy in the U.S. (Offered every other year)	3
B. Elective Courses (9 hours)	
Africana Studies	
AFST 5314, Theories in Africana Studies	**3**
AFST 5354, Topics in Africana Studies	**3**
AFST 5434, History of Africana People	**3**
History	
HIST 5114, the U.S. to 1877	**3**
HIST 5684, the U.S. South	**3**
HIST 5914, Race & Slavery in Comparative Perspective	**3**
Human Development	

HD 5634, Legislation and Policy in Human Development	**3**
Sociology	
SOC 5034, Social Inequity (Offered every other year)	**3**
SOC 5917, Aging in Social Context (Offered every other year)	**3**
SOC 5984, Race and Social Inequity (Offered every other year)	**3**
SOC 5414, Crime, Control and Social Inequity	**3**
SOC 6214, Race and Mental Health (Offered every other year)	**3**

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Religion and the Public Sphere
RPSC

Address:
115A Major Williams Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Prof. Matthew Gabriele

Web Resource(s):
• Dept. of Religion & Culture
• Religion & Public Sphere

Phone Number(s):
• *Dept. of Religion & Culture:*
540/231-6551

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The purpose of the graduate certificate in Religion and the Public Sphere is to teach students from various disciplines to apply knowledge about the role of religion plays in the public sphere. Students will address the role of religion in political and public spaces where citizens debate public affairs, beyond the theological and private spaces with which religion is ordinarily associated.

In recent years, religion has increasingly been a focus of national and international politics, an important cultural force, and a subject of significant public concern in modern law, policy making, and international relations. The graduate certificate in Religion and the Public Sphere introduces graduate students to contemporary histories of religious influence and to debates out the role of religion in the public sphere, debates about secularism, secularization, and the differentiation between religion and politics. Students will also consider some of the major thinkers and themes of modern religious thought and the economic, political, and legal aspects of the location of religion in the modern world.

Graduates of the certificate will be will be prepared navigate the complex political, social, economic, and legal dimensions of role of religion and its recent resurgence. Students will be able to apply that knowledge to questions concerning religion which they will encounter in a variety of workplace contexts, including, but not limited to, journalism, law, NGOs, and the policy world. Such a credential would also enable degree-seeking students at Virginia Tech and opportunity to formalize their interest in religion and apply for teaching, research, and policy positions that involve the study of religion.

How to Apply:
Fill out the online application for participation in the certificate program.

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Religion and the Public Sphere
RPSC

Address:
115A Major Williams Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Prof. Matthew Gabriele

Web Resource(s):
• Dept. of Religion & Culture
• Religion & Public Sphere

Phone Number(s):
• *Dept. of Religion & Culture:*
540/231-6551

Admission Requirements

Degree seeking students will:

- Submit a Graduate Certificate Application
- Possess a bachelor's degree from an accredited institution with a GPA of 3.0 or higher

Non-degree seeking students will:

- Submit a Graduate School Application for Admission and pay the fee
- Submit a Graduate Certificate Application and pay the fee
- Submit official undergraduate transcripts demonstrating a bachelor's degree conferral
- Possess a bachelor's degree from an accredited institution with a GPA GPA of 3.0 or higher

Students who have not earned a degree in the United States must submit:

- Test of English as a Foreign Language (TOEFL) minimum score of 90 on the internet-bested test (iBT) of the International English Language Testing System (IELTS) with a minimum score of 6.5
- TOEFL scores of 20 of greater in Listening, Writing, Speaking, and Reading subsections.

Curriculum

Number of Credit Hours

- 12 credit hours of graduate level courses.

Core courses—6 credit hours

- RLCL 5014—Religion and the Public Sphere (3 credits) (this is a new course which has just passed the CLAHS Graduate Curriculum Committee)
- RLCL/ASPT 5124: Religion and Modernity in the West (3 credits)

Restricted elective courses—3 credit hours

One of the following:

- RLCL/HUM 5584—Topics in Public Humanities (3 credits)
- RLCL/ASPT 5134: Islamic Political Thought (3 credits)
- RLCL/ASPT 6024: Contemporary Religious Thought (3 credits)

Unrestricted elective courses—3 credit hours

- One elective course from the list above or another 5000-level or 6000-level course subject to approval by the certificate candidate's advisor

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Remote Sensing
RMSC

Address:
Cheatham Hall, RM 319, MC0324 310 West Campus Dr
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Randolph H. Wynne
• Valerie A. Thomas
• Joseph B. Baker

Web Resource(s):
• Remote Sensing IGEP

Phone Number(s):
• *Randolph H. Wynne:* 540/231-7811
• *Valerie A. Thomas:* 540/231-0958
• *Joseph B. Baker:* 540/231-3355

Certificate Overview | Admissions & Course Requirements

Overview

Remote sensing provides technical and methodological approaches to holistically study human activities that have an impact on the Earth's sometimes poorly understood physical processes. Because remote sensing systems are often sensitive to wavelengths outside the visible portion of the electromagnetic spectrum (e.g., the infrared and microwave) they allow us to expand our view and "see" the world in a different way. Objective, inter-calibrated, and synoptic data streams from a wide variety of sensors and platforms have become increasingly available since the dawn of the space age. For some systems, archives contain several decades of imagery portraying interactions between humans and the Earth's environment. While the information resulting from analysis of these data is, by itself, policy relevant, only by combining the information available from remote sensing with the knowledge, approaches, and analytical tools of the social and natural sciences can complex issues at the interface of science and society be addressed. Further, remote sensing itself engenders a variety of social and policy questions, ranging from personal privacy to the social and cultural change that inevitably results from the wide adoption of transforming technologies.

How to Apply:
Fill out the online application for participation in the certificate program.

Remote Sensing RMSC

Address:
Cheatham Hall, RM 319, MC0324 310 West Campus Dr
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Randolph H. Wynne
• Valerie A. Thomas
• Joseph B. Baker

Web Resource(s):
• Remote Sensing IGEP

Phone Number(s):
• *Randolph H. Wynne:* 540/231-7811
• *Valerie A. Thomas:* 540/231-0958
• *Joseph B. Baker:* 540/231-3355

Certificate Overview | Admissions & Course Requirements

Admission

Admission to the Graduate School and completing a Graduate Certificate Application are required for all students. For both degree-seeking and non-degree-seeking students, the Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better for admission to Certificate Status. Applicants with an undergraduate GPA < 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program. Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study.

Course Requirements

The program requires 10 hours of graduate-level credit to obtain a Graduate Certificate in Remote Sensing from Virginia Tech. At least 2/3 of these courses must be graded A-F. Course credits from below 5000-level courses are not permitted. Two courses (4 credit hours total) will be mandatory for all students in the program: the Seminar in GIS and Remote Sensing as well as Remote Sensing of Natural Resources. In addition, students will then be required to complete two of the following three options to complete their program: Remote Sensing Engineering Principles, Remote Sensing in the Social Sciences, and Introduction to Science and Technology Policy. This set of courses will ensure that all students, regardless of disciplinary background, will be exposed to the same types of research approaches. Further, all students will discuss common scientific and policy issues that have evolved from increasing natural and anthropogenic stresses on the earth system – stresses that are driving research and development in this field. When students finish the course requirements, the oversight committee chair will sign the Course Check Sheet. Students will need to submit an Application for Conferral of Certificate form to the Graduate School. Transfer credits are not permitted.
Courses:
Required Courses:

- Remote Sensing Engineering Principles (ECE 5194, I, 3H, 3C)
- Remote Sensing of Natural Resources (FOR 5254, II, 3H, 3C)*
- Remote Sensing in the Social Sciences (AAEC/GEOG/FREC 5544, I, 3H, 1L, 4C)
- Seminar in GIS and Remote Sensing (FOR/GEOG 5104, II, P/F, 1H, 1C)
- Introduction to Science and Technology Policy (STS 5614, II, 3H, 3C)

Total credits for certificate = 10; No grade below "B" is accepted

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Research in Translational Medicine
RTMC

Address:
Graduate School (MC 0325), Graduate Life Center, Virginia Tech, 155 Otey ST NW
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• William Huckle
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *William Huckle:* 540/231-6691
• *Graduate School Admissions:* 540/231-8636

Certificate Overview

Translational medicine research encompasses 4 broad categories that include moving a scientific discovery into a clinical health application (T1-Bench to Bedside), a health application to evidence-based guidelines (T2-Bedside to Guidelines), guidelines to typical practice (T3-Guidelines to Delivery), and practice to sustainable policies (T4-Delivery to Policy). The progression across categories can be linear, asynchronous, and bi-directional. Thus, just as this process can move from bench to bedside, for example, it can also move from bedside to bench. Implicit in the translational process is the need for a multidisciplinary and team science approach.

This certificate responds to the National Institute of Health's Roadmap for Medical Research, launched in 2004 to promote biomedical research (http://commonfund.nih.gov/aboutroadmap.aspx) and to Virginia Tech's initiatives to expand educational and research programs in the health sciences. It provides the opportunity for graduate students to acquire specialized expertise in translational medicine research methods along with focal studies in their majors. According to Bureau of Labor Statistics projections, career opportunities for medical scientists are expected to grow "much faster than average" (defined as an increase of 20% or more) from 2008 to 2018 (http://www.bls.gov/oco/ocos309.htm#outlook).

How to Apply:
Fill out the online application for participation in the certificate program.

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Research in Translational Medicine
RTMC

Address:
Graduate School (MC 0325), Graduate Life Center, Virginia Tech, 155 Otey ST NW
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• William Huckle
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *William Huckle:* 540/231-6691
• *Graduate School Admissions:* 540/231-8636

Admission Requirements

- Admission to the Graduate School: Completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better and English language proficiency
- Admission to a graduate degree program
- Completion of the certificate application form

Course Requirements

The Graduate Certificate in Research in Translational Medicine requires completion of three modules focused on translational medicine course content, research methods and statistics, and research experience that links science to medical practice (24 cr). Course selection is based on individual students' background, research focus, and career goals. Students should work with their major professors and advisory committee members to identify appropriate courses and research experiences. Courses taken for the Certificate can also count toward the degree plan of study.

Module	Content	Minimum Number of Graduate Credits
1	Demonstration of subject matter expertise via courses relevant to translational medicine topics in student's major	9 cr (graded A-F unless only taught P/F)
2	Demonstration of competence in research methods and statistics related to translational medicine research via courses in research design, experimental procedures and other methods of data collection, and data analysis techniques	9 cr (graded A-F)
3	Demonstration of competence in conducting translational medicine research	6 cr of 5904, 5994, or 7994 (graded EQ)

Example Tracks

Biomedical Aspects	Biochemical/Molecular Biology/Genomics
	Biomedical Engineering and Bioinformatics

Behavioral & Social Aspects	Behavioral Science and Medicine
	Health Policy

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Science and Technology Studies
STC

Address:
_____ 121 Lane Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Carol Sue Slusser

Web Resource(s):
• Website

Phone Number(s):
• *Graduate and Undergraduate Coordinator:* 540/231-0719

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Science and Technology Studies (STS) graduate certificate offers the opportunity to learn and develop competency in various aspects of the relations between science, technology, and society. It is intended to serve both existing graduate students in other programs at Virginia Tech and non-degree-seeking students interested in career advancement. For example, an STS certificate might help: a graduate student in Public Administration launch a career in administering a science-policy oriented NGO; a biology student who wants training in public engagement; or a graduate student in Philosophy who wishes to buttress a focus on the philosophy of science. Mid-career professionals who are not particularly interested in another degree may find the Certificate useful for building new competencies in areas such as technology analysis, science policy, or the public understanding of science.

How to Apply:
Fill out the online application for participation in the certificate program.

Science and Technology Studies
STC

Address:
_____ 121 Lane Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Carol Sue Slusser

Web Resource(s):
• Website

Phone Number(s):
• *Graduate and Undergraduate Coordinator:*
540/231-0719

Admission Requirements

Graduate students accepted in any other graduate program at Virginia Tech would be admitted to the STS graduate certificate program on the basis of their acceptance to their home department.

Recommendations for admission to the certificate program for non-degree-seeking students would be made by the STS Graduate Admissions Committee, based on transcripts, a writing sample, a statement of purpose, and the minimal requirements specified in the Graduate Catalogue for admission to the Graduate School. (These admissions criteria differ from our regular degree admissions in that they require neither the GRE nor letters of recommendation.)

Course Requirements

The certificate requires successful completion of twelve hours from the courses listed below, with grades of B+ or better. Only in extraordinary circumstances would substitutions for core courses be allowed. Any elective course substitution would require the approval of the Director of Graduate Studies.

Only six credits can be double-counted for this certificate and a graduate degree. Transfer credits are not permitted.

Core Courses (select three from the following list):

- STS/SOC 5105: Social Studies of Science and Technology I
- STS/SOC 5106: Social Studies of Science and Technology II
- STS/HIST 5205: History of Science
- STS/HIST 5206: History of Technology
- STS/PHIL 5305: Philosophy of Science and Technology I
- STS/PHIL 5306: Philosophy of Science and Technology II
- STS/PAPA 5614 Introduction to Science and Technology Policy

Elective Courses (select one from the following list):

- STS 5424: Topics in Science and Technology Studies
- STS 5444: Issues in Bioethics
- STS/HIST 5405: Development of Modern American Science
- STS/HIST 6224: Science, Technology, and the Enlightenment
- STS/HIST 6234: Advanced Topics in the History of Modern Science, Technology, and Medicine
- STS/PHIL 6314: History of Philosophy of Science
- STS/PHIL 6334: Advanced Topics in Philosophy of Science
- STS 6524: Critical Approaches to Science and Technology
- STS 6534: Cultural Studies of Science and Technology
- STS/PHIL 6514: Cognitive Studies in Science and Technology
- STS 6614: Advanced Topics in Technology Studies
- STS 6624: Advanced Topics in the Life Sciences and Medicine

- STS/PHIL 6634: Advanced Topics in Natural Philosophy
- STS/PAPA 6664: Advanced Topics in Science and Technology Policy
- STS/SOC 6824: Normative Structuring of Science and Technology
- STS/SOC 6834: Advanced Topics in Social Studies of Science and Technology
- PSCI/GIA 5354: Public Policy Analysis
- PSCI/GIA 5214: Contemporary Political Theory
- SPIA/GIA 5454: Advanced Topics in Information Technology and Public Policy
- SPIA/GIA 5555: Culture, Politics, and Society in a Networked Environment
- UAP 5564: Information Technology, Society, and Public Policy

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Science, Technology, and Engineering in Policy
STEC

Address:
263A Steger Hall (MC 0477)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• tschenk@vt.edu

Web Resource(s):
• https://step.vt.edu

Phone Number(s):
• *Todd Schenk:* 540/231-1803

Science, Technology & Engineering in Policy (STEP)

The STEP graduate certificate enhances the capacities of science, technology, engineering, mathematics, and health care (STEM-H) graduate students to be effective participants and collaborators in policy processes. The program develops participants' abilities to engage with complex public problems, recognizing that they are social and technical in nature.

Program goal: Develop and enhance STEM-H graduate students' understanding of policy processes and capacity to integrate scientific and engineering knowledge with public policy reasoning.

Program learning objectives:

- Analyze how policy processes unfold using concepts and constructs that explicitly consider governance institutions and decision dynamics.
- Apply a suite of quantitative and qualitative tools to identify and address the multiple dimensions of complex policy development and implementation challenges.
- Analyze governance practices taking public values, ethical considerations, and the heterogeneous perspectives and needs of different stakeholders into account.
- Collaboratively engage a broad range of professional and public stakeholders to improve policy decisions.
- Effectively translate and communicate scientific and technical information to non-technical audiences.
- Map relationships between scientific and technical information and public policy.
- Compare and contrast policy standards and norms with scientific and technical norms and practices.

For more information, please visit www.step.vt.edu or contact Program Director Todd Schenk at tschenk@vt.edu

How to Apply:
Fill out the online application for participation in the certificate program.

Science, Technology, and Engineering in Policy
STEC

Address:
263A Steger Hall (MC 0477)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• tschenk@vt.edu

Web Resource(s):
• https://step.vt.edu

Phone Number(s):
• *Todd Schenk:* 540/231-1803

STEP Graduate Certificate - Admission Requirements & Process

If you are a **current Virginia Tech graduate student**, you may apply for the program by completing the ***Graduate Certificate Application*** and returning it to the Graduate School. Applications will be reviewed by the Program Director and Graduate School.

The certificate program is **also open to those not currently enrolled** in a graduate degree program at Virginia Tech. In order to apply, please complete the ***Graduate Certificate Application.*** You must also submit a general ***Graduate School Application***, pay the fee, and submit official undergraduate transcripts demonstrating bachelor's degree conferral. In order to be ***eligible*** for this graduate certificate program, you must possess a bachelor's degree from an accredited institution with a GPA of 3.0 or better. If you did not earn your degree in the United States must submit Test of English as a Foreign Language (TOEFL) results showing a minimum score of 90 on the internet-based test (iBT) or the International English Language Testing System (IELTS) with a minimum score of 6.5; and TOEFL scores of 20 or greater in Listening, Writing, Speaking, and Reading subsections.

For more information, please visit www.step.vt.edu and/or contact STEP Program Director, Dr. Todd Schenk, at tschenk@vt.edu.

STEP Graduate Certificate - Course Requirements

The STEP graduate program requires 12 credit hours of graduate-level coursework.

The core required courses are (10 credits total):

Policy Gateway: Policy and Decision Making in STEM-H Domains
PSCI 5104 (SPIA 5104) (STS 5104)
Key concepts in policymaking, including policy analysis and decision making in complex social and technical settings. Policy process theories and evaluation tools. Concepts of governance including public values, ethics, and variable impacts across communities. Relationships among public policy decision processes and science, technology, and engineering, including disciplinary norms. Pre: Graduate standing (3H, 3C)

Decision Making, Reflective Practice, and Engagement in STEM-H Domains
SPIA 5124 (PSCI 5124) (STS 5124)
In-depth, case-based exploration of roles of science, engineering and technology in policy-making. Application of theories, concepts and practices for policy decision-making, including stakeholder engagement, human behavior, and organizational development. Critical examination of ethics, and fostering of reflective practice. Implications of "big data". Pre: Graduate standing (3H, 3C)

Tools and Approaches for Policy-Making in STEM-H Domains
STAT 5134 (SPIA 5134) (PSCI 5134)
Techniques for translating theory-driven, qualitative concepts into quantitative data-focused modeling. Quantitative and computational tools including statistical inference and hypothesis testing, system dynamics, and economic analysis. Modern data analytic practices, including good collection, storage, and visualization techniques. Understanding complexity. Critical examination of challenges and common pitfalls in quantitative modeling. Pre: Graduate standing (3H, 3C)

Science, Technology, and Engineering in Policy Seminar
STS 5154 (SPIA 5154) (PSCI 5154)
Presentation of research on STEM-H, public policy, and ethics. Professional development. Research resources and tools. Project management and funding opportunities. Publishing standards and processes across disciplines. STEM-H and policy practitioner engagement. Multidisciplinary communication. May be repeated up to six times, as seminar and presentation topics will change each semester. Pass/Fail only. Pre: Graduate standing (1H, 1C)

The **additional 2 required credits** may be acquired by taking a 5000 level or higher policy-related elective course from within your discipline. Alternatively, the credits may be acquired through:

Communicating Science
GRAD 5114
Practice-based pedagogy techniques for effective communication about scientific, technical, and health research. Application of communication techniques across public and professional audiences and a variety of oral and written communication contexts. Pre: Graduate standing (2H, 2C)

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Security Studies
PSOC

Address:
Political Science (0130) Major Williams Hall Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Website

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The graduate certificate program in Security Studies is designed for non-degree-seeking students and graduate students at Virginia Tech who wish to demonstrate special competence in Security Studies. This certificate program responds to existing demand by degree-seeking and non-degree students, studying on campus or through on-line courses. Study security issues in a holistic lens. Learn how to think critically, write concisely and brief effectively by acquiring the knowledge, skills, and abilities needed to gather, analyze, and interpret quantitative and qualitative data relating to questions of national and international security, defense policy in specific world regions, terrorist and counterterrorist operations, and insurgency, counterinsurgency, and urban warfare.

How to Apply:
Fill out the online application for participation in the certificate program.

Security Studies
PSOC

Address:
Political Science (0130) Major Williams Hall Room 515 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Graduate Program Director

Web Resource(s):
• Website

Phone Number(s):
• *General Contact:* 540/231-6572
• *Graduate Program Director:* 540/231-8843

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Applications for the Graduate Certificate in Security Studies will be considered from students enrolled in a graduate degree program at Virginia Tech and from non-degree and Commonwealth Campus students who have been permitted to take courses by the Graduate School. Certificates will be awarded upon application for the certificate and application for certificate conferral once course requirements have been completed.

Course Requirements

Completion of a total of twelve credit hours; 6 credits in required courses and 6 elective hours. Students must receive a grade of B or better in each course.

(Note: Students will not be allowed to retake a course for a better grade if they receive below a B.)

Required courses:

- PSCI 5444 - International Politics
- PSCI 5484 - American Foreign Policy

In addition, students must complete at least 6 credit hours from the following:

- PSCI 5324 - Executive Branch
- PSCI 5464 - Critical Security Studies
- PSCI 5474 - Global Governance
- PSCI 5514 - Global Security
- PSCI 5524 - U.S. Foreign Policy after 9/11

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Software Development
SWDC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Graduate Certificate in Software Development

The purpose of this certificate is to provide students with a solid foundation in the tools and principles that underlie modern software development. The emphasis is on object-oriented software design and development, the most widely used approach for building complex software systems today. Beyond just learning to program, the certificate will prepare students to plan, manage, and assess software development projects and software quality. The emphasis in applications will be on distributed systems (e.g., web, cloud, mobile), which represents the most rapidly growing sector of software development.

For many years, every Bureau of Labor Statistics projection of employment growth has listed software engineering and software development as an area with great demand. Computer Science departments alone cannot graduate enough students to meet this demand. In many cases, students with non-CS undergraduate degrees can take advantage of informal and self-study resources to learn to program. However, in order to undertake a major software development effort, advanced training is critical. This certificate will be an efficient mechanism for students from a variety of backgrounds to gain the foundation they need to participate in and even lead significant software development projects.

Learning Outcomes: Students who complete this certificate will be able to,

- Design and implement software systems using an object-oriented language such as Java.
- Identify and apply appropriate design patterns and software development processes to develop software systems.
- Learn languages and technologies needed to develop applications for modern mobile devices.
- Design and implement distributed software systems deployed over a web-based and cloud-based environment.

How to Apply:
Fill out the online application for participation in the certificate program.

Software Development
SWDC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 365
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• MIT Email

Web Resource(s):
• MIT Website
• MIT Certificates Website

Phone Number(s):
• *MIT Office:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Admission Requirements for the Graduate Certificate in Software Development

Virginia Tech requires admission to the Graduate School and completion of a Graduate Certificate Application for both degree- and non-degree seeking certificate applicants.

Degree-seeking applicants: The Graduate School requires completion of a bachelor’s degree from an accredited institution with a GPA of 3.0 or greater for admission to Certificate Status. Applicants with an undergraduate GPA less than 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program.

For students interested in pursuing both the MIT degree and the certificate(s),no more than fifty percent of certificate courses will be included toward completion of the MIT degree.

Non-degree seeking applicants: Applicants that wish to obtain a graduate certificate only, without being enrolled in a degree program, may apply by completing an abbreviated application to the Graduate School. The Graduate Certificate Application Form is required after admission.

Applicants must meet the following criteria:

- Earn a GPA of 3.0 or greater or credits earned during the last half of their undergraduate degree
- Submit official transcripts
- Meet the academic background requirements of the admitting academic unit
- International Applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS).
    - Earn a minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT). For the iBT, earn a minimum of 20 on each subject test (Listening, Speaking, Reading, and Writing).
    - Earn a minimum IELTS score of 6.5.
    - Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Admissions - MIT Graduate Certificates

Curriculum Requirements for the Graduate Certificate in Software Development

Number of Credit Hours:

A total of twelve credit hours are required. Transfer credits are not permitted. Students must maintain a minimum GPA of 3.0 in the designated courses.

Required Courses:

CS 5044: Object-Oriented Programming with Java: Object-oriented programming concepts and the Java programming language. The application of design strategies, notations, and patterns related to object-oriented systems. Techniques and libraries for developing applications related to the World Wide Web. Pre: Proficiency in a high-level programming language (e.g., C#, C, C++, or Java).

CS 5244: Web Application Development: Languages and technologies needed to develop modern data-centric web applications. Commonly used protocols and standards. Client-side technologies such as HTML, CSS, and JavaScript; server-side technologies such as Servlets and JSP; and database access with SQL. Principles and technologies for web application architecture, electronic commerce, and web application security. Pre: CS 5044.

CS 5704: Software Engineering: Study of the principles and tools applicable to the methodical construction and controlled evolution of complex software systems. Tools for all phases of the life cycle are presented; particular attention focuses on the design, testing, and maintenance phases. Attention to measurement models of the software process and product, which allow quantitative assessment of cost, reliability, and complexity of software systems. Pre: CS 5044.

CS 5254: Mobile Application Development: Languages and technologies needed to develop applications for modern mobile devices. Mobile infrastructure and devices. Interactive graphical user interfaces for mobile devices. Protocols and standards for using mobile device features such as sensors, networking, location, camera, and audio. Mobile app architecture, performance consideration, and asynchronous programming. Principles and technologies for mobile security. Pre: CS 5044

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Technology Management
TMC

Address:
VT ISE Department 250 Durham Hall (0118) Blacksburg, VA
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Hannah Parks

Web Resource(s):
• TM Certificate

Phone Number(s):
• *Hannah Parks:*
540/231-5586

Certificate Overview | Admissions & Course Requirements

Technology Management

A four-course academic program focused on the establishment, operation and management of enterprise capabilities for technological innovation – addressing the full spectrum of basic science (research), technology development (invention/intellectual property), product/service development, commercialization, deployment, maintenance, modernization, and retirement of performance enabling technologies.

How to Apply:
Fill out the online application for participation in the certificate program.

Technology Management
TMC

Address:
VT ISE Department 250 Durham Hall (0118) Blacksburg, VA
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Hannah Parks

Web Resource(s):
• TM Certificate

Phone Number(s):
• *Hannah Parks:*
540/231-5586

Admission Requirements

Bachelor's degree in science or engineering with undergraduate grade point average that meets VT Graduate School requirements for admission (other undergraduate degrees that included appropriate coursework in mathematics and statistics may also qualify).

Course Requirements

ISE 5164 Transfer and Application of Emerging Technology

ISE 5174 Engineering Program and Project Management

ISE 5154 Applied Human Factors Engineering

ISE 5134 Management Information Systems

All courses must have a grade of B or better. Transfer credits are not permitted.

Transportation Planning and Policy
TPPC

Address:
600 North Glebe Road, VTRC Room 6-102
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• Ralph Buehler

Web Resource(s):
• TPP Website

Phone Number(s):
• *Program Director:* 571/858-3111

Certificate Overview | Admissions & Course Requirements

Transportation Planning and Policy

The graduate certificate in Transportation Planning and Policy is designed to teach students about transportation systems and related public policies. Students will learn about travel behaviors and the socioeconomic impact that transportation systems have on surrounding areas (e.g., local, regional, national). Transportation systems can include personal transportation systems (e.g., automobile, bicycle, scooter) and public transportation systems (e.g., buses, trains/subway, shared bicycle/car programs). The program covers topics such as transportation policy and planning issues associated with land use patterns, resource allocations, and changing political environments. Graduates will be prepared to contribute to transportation planning and associated public policies.

How to Apply:
Fill out the online application for participation in the certificate program.

Transportation Planning and Policy
TPPC

Address:
600 North Glebe Road, VTRC Room 6-102
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• Ralph Buehler

Web Resource(s):
• TPP Website

Phone Number(s):
• *Program Director:*
571/858-3111

Admission Requirements

Students can apply for the Transportation Policy and Planning certificate as a degree-seeking student or non-degree Commonwealth Campus student at Virginia Tech, or as a visiting student from another institution. If you are not currently enrolled as a graduate student, you must apply for graduate admission through the Virginia Tech Graduate School as a Graduate Certificate status applicant. Requirements for admission include:
Completed undergraduate degree; 2-3 Letters of Recommendation; Current resume/ CV; Personal goal statement; Completed application; No GRE required; TOEFL may be required for international students.

Course Requirements

Number of Credit Hours

12 credit hours of graduate level courses

Core Courses: 6 credit hours

UAP 5644: Transportation Systems Planning (3 credits)

UAP 5864: Topics in Transportation Planning and Policy (3 credits)

Restricted Elective courses: 6 credit hours

Students will select two courses from the following list.

UAP 5114: Computer Applications in Urban Planning and Management (3 credits)

UAP 5224: Planning Methods and Technologies (3 credits)*

UAP 5424: Metropolitan Planning Topics (3 credits)

UAP 5794: Environmental Planning Studio (3 credits)

*Students in the Masters of Urban and Regional Planning (MURP) program are encouraged to choose electives other than UAP 5224 because UAP 5224 is a required core class for MURP.

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Urban Computing
UCC

Address:
Torgersen Hall, Suite 3160
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wanawsha Shalaby

Web Resource(s):
• Graduate Certificate in Urban Computing

Phone Number(s):

Certificate Overview

The Graduate Certificate in Urban Computing trains students in the latest methods in analyzing massive datasets to study key issues concerning urban populations. Students learn to apply methods in data analytics, computational modeling, and visualization. The certificate is open to degree- and non-degree seeking students. Students complete 12 hours of coursework for the certificate from an interdisciplinary selection, spanning Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Mathematics, Population Health Sciences, Sociology, Statistics, and Urban Affairs and Planning.

The Graduate Certificate in Urban Computing is available to all graduate students in the university. Graduate students can select courses from the list of approved courses. At least 2 of the courses must be from outside the student's home department. All courses are 3-hour credit unless otherwise noted in the Graduate Catalog. Transfer credits are not permitted. No hours can be below the 5000 level.

Details of course requirements and program checksheet are available at https://sanghani.cs.vt.edu/academics/urban-computing/

How to Apply:
Fill out the online application for participation in the certificate program.

Urban Computing
UCC

Address:
Torgersen Hall, Suite 3160
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wanawsha Shalaby

Web Resource(s):
• Graduate Certificate in Urban Computing

Phone Number(s):

Admission Requirements

Admission:
Admission to the Graduate School and completing a Graduate Certificate Application are required for both degree- and non-degree seeking students.

Degree-seeking applicants:

The Graduate School requires completion of a bachelor's degree from an accredited institution with a GPA of 3.0 or better for admission to Certificate Status. Applicants with an undergraduate GPA < 3.0 may qualify for Commonwealth Campus admission. Students pursuing a degree and a certificate simultaneously are classified within their degree program. Certificate credits may be used to meet degree requirements if they are appropriate for inclusion on the degree Plan of Study.

Non-degree seeking applicants:

A qualified person who wishes to enter Virginia Tech to obtain a graduate certificate, without being enrolled in a degree program, may apply for graduate admission to Graduate Certificate status. Such applicants submit an Application for Admission and a Graduate Certificate Application, https://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/forms/Application_for_Graduate_Certificate_Program.pdf, and must meet the following criteria:

- GPA of 3.0 for admission for the last half of the credits earned for the undergraduate (bachelors) degree*
- Official transcripts must be submitted.
- Academic background meets the requirements of the admitting academic unit.
- International applicants must submit scores from the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). A minimum TOEFL score of 550 paper-based (PBT) or 80 internet-based test (iBT) is required for consideration of the application. On the iBT, subscores of at least 20 on each subtest (Listening, Speaking, Reading, and Writing) are required for admission. A minimum IELTS score of 6.5 is required for admission. Some departments have higher TOEFL or IELTS score requirements than those set by the Graduate School.

Course Requirements

A. Required Core Courses: (6 credit hours minimum)

CS 5834 Introduction to Urban Computing

CS 5024 Ethics and Professionalism in Computer Science

B. Restricted Elective Courses: (6 credit hours minimum)

"Horizontals" (Data Science/Research Methods) Courses (Choose 1)

CS 5234 Advanced Parallel Computation

CS/MATH 5485 Numerical Analysis and Software I

CS/MATH 5486 Numerical Analysis and Software II

CS/STAT 5525 Data Analytics I

CS/STAT 5526 Data Analytics II

CS 5824/ECE 5424G: Advanced Machine Learning

CS 5764 Information Visualization

STAT 5444 Bayesian Statistics

STAT 5544 Spatial Statistics

"Verticals" (Urban Informatics/Applications) Courses (Choose 1)

CEE 5604 Traffic Characteristics and Flows

CEE 5634 Analysis & Planning of Mass Transit Systems

PHS/VM 5314 Infectious Disease Epidemiology

PHS 5354 Modeling Infectious Diseases

ECE 6304 Advanced Topics in Power

ECE 6334 Computational Methods in Power Engineering

SOC 5504 Population Processes and Policies

SOC 6504 The Sociology of Culture

**UAP 5114 Computer Applications in Urban Planning and Management

UAP 5234 Urban Economics and Policy

UAP 5604 Housing Planning and Policy Topics

UAP 5644 Transportation Systems Planning

** = students in the UAP department pursuing the certificate are advised, based on their background, to take UAP 5114 Computer Applications in Urban Planning and Management as a pre-requisite for CS 5834 Introduction to Urban Computing. Students should enroll in the section taught by either Wenwen Zhang or Theo Lim.

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Urban Planning Analytics
UPAC

Address:
900 North Glebe Road, VTRC Room 5-038
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• UAP

Web Resource(s):
• Urban Planning Analytics

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Urban Planning Analytics Certificate

The certificate trains students to make decisions that are not only technically efficient, economically sound, environmentally aware, but also socially, ethically, and politically informed. In addition, the certificate equips students with essential foundational skills that arise from actively engaging in data science combined with an understanding of cities as systems. In doing so, the certificate promotes the educational mission of Virginia Tech to offer its students an innovative, interdisciplinary learning environment in which they can take leadership roles in data sciences for the cities of tomorrow. The certificate seeks to meet the increasing workforce demand for analytical skills and literacy.

How to Apply:
Fill out the online application for participation in the certificate program.

Urban Planning Analytics
UPAC

Address:
900 North Glebe Road, VTRC Room 5-038
Arlington, VA 22203

Contact this Certificate

Email Contact(s):
• UAP

Web Resource(s):
• Urban Planning Analytics

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Eligibility

Open to Virginia Tech students located at either the Blacksburg or National Capital Region campus who are pursuing a Masters or Ph.D. We welcome students from disciplines across campus, such as:

- Urban Affairs and Planning
- Civil and Environmental Engineering
- Computer Science
- Landscape Architecture
- Architecture
- Building Construction
- Sociology
- Statistics

Course Requirements

Students will be required to complete coursework to develop knowledge and skills related to data analytics and public policy for cities and urbanized places. Students will gain an understanding of the fundamental competencies needed for data collection, cleaning, management, and analysis as well as manage teams that conduct analyses related to cities. Students seeking the Certificate must complete the following four courses (click course name for most recent syllabus):

UAP 5114: Computer Applications in Urban Planning and Management

UAP 5224: Planning Methods and Technologies

UAP 5494: Advanced Quantitative Techniques for Urban Research

UAP 5564: Information Technology, Society, and Public Policy

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Watershed Management
WSMC

Address:
Virginia Water Resources Research Center (0444) 210-B Cheatham Hall 310 West Campus Drive
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Kevin McGuire

Web Resource(s):
• Website

Phone Number(s):
• *Kevin McGuire:*
540/231-6017

Certificate Overview | Admissions & Course Requirements

Certificate Overview

In the 21st century, challenges that relate to watershed management and the need to protect water quantity and water quality will be intensified in Virginia and the nation, owing to increased water demand, changes in land-use, and other competing interests. Management of water resources is a critical issue facing governmental agencies, as well as the private/industrial sector and citizens. Universities and colleges have a major responsibility to prepare future water and land managers to meet these challenges. Future water managers and decision makers need knowledge and training in natural science, technical assessment, economics, planning, and policy. In recent years, it has been recognized that the most effective approach to management of water resources is at the watershed scale with input from various stakeholders. Furthermore, there have been significant advances in understanding watershed science both in the natural and social sciences, and there is a national trend to integrate various facets of watershed studies in interdisciplinary programs. The Watershed Management Certificate (WSMC) program at the graduate level integrates existing programs and courses from five colleges and ten departments at Virginia Tech to provide an interdisciplinary and substantive understanding of watershed science, policy, and decision-making. The program provides excellent opportunities for students from many disciplines to study watershed management and develop interdisciplinary skills necessary for effective professional work in this emerging field. The program is designed to prepare Virginia Tech graduates for critical future tasks and will be a strong incentive for others who consider enrollment at Virginia Tech, Blacksburg.

How to Apply:
Fill out the online application for participation in the certificate program.

Watershed Management
WSMC

Address:
Virginia Water Resources Research Center (0444) 210-B Cheatham Hall 310 West Campus Drive
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Kevin McGuire

Web Resource(s):
• Website

Phone Number(s):
• *Kevin McGuire:*
540/231-6017

Admission Requirements

Virginia Tech students accepted in any graduate program category: PhD, MS, MA, Commonwealth Campus, or Non-Degree can be admitted into the WSMC program by completing the Graduate Certificate Application, and completing a plan for taking courses required on the course checklist below. Students should meet with an academic adviser familiar with the classes on the list below and submit the application form to Dr. Kevin McGuire for the Certificate Program Approval signature no less than six months prior to completion of coursework.

After completing the 11-12 hours of courses required, take the course requirements checksheet (available on the WSMC webpage: http://www.vwrrc.vt.edu/watershed-management-graduate-certificate) to Dr. McGuire for signature. Students should bring a copy of their transcript for verification purposes. Submit the signed course requirements checksheet to Dr. McGuire no less than six months prior to completion of course requirements, or as soon as possible to meet the Graduate School deadlines. Transfer credits are not permitted.

Upon successful completion of certificate requirements, an Application For Certificate Conferral must be signed by the department and submitted by the Application for Degree deadline in the term in which the certificate will be awarded. The Graduate School will then check to see that courses listed on the Certificate Application form were satisfactorily taken (i.e., grades for certificate courses must be “C” or higher and the overall certificate GPA must be 3.0 or higher).

Course Requirements

A. Required Core Course: Watershed Management (3 credit hours):

Choose one of the courses below:

UAP 5134G Land Use and Environment: Planning and Policy

UAP/NR 5414 Natural Resources Planning (NCR)

B. Additional Courses (8-9 credit hours):

1. Watershed Science (choose 1 course, 3 hours):

BSE 5404 Agricultural Nonpoint Source Pollution

FREC 5354G Advanced Forest Soils and Hydrology

LAR 5304G Topics: Advanced Landscape Architecture Technology - Hydrology

FIW 5534G Advanced Wetland Ecology and Management

NR 5884 Watershed Science, Education & Leadership (NCR)

CEE 5324 Advanced Hydrology (NCR)

CEE 5734 Urban Hydrology and Stormwater Management

GEOS 5804G Advanced Groundwater Hydrology

FIW 5814 Stream Habitat Management

2. Watershed Analysis (choose 2 courses, 5-6 hours):

BIOL 5034 Ecosystem Dynamics

BSE 5244 GIS in Hydrologic Analysis

BSE 5354 Nonpoint Source Pollution Modeling

CEE 5204 GIS Applications in Civil and Environmental Engineering (NCR)

FREC 5254 Remote Sensing of Natural Resources

FREC 5264 GIS Applications in Natural Resources Management

LAR 5044 Land Analysis and Site Planning

CSES 5854 Advanced Wetland Soils

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Women's & Gender Studies
WGSC

Address:
507 McBryde Hall (0137), 225 Stanger St Virginia Tech
Blacksburg, VA 24061-0137

Contact this Certificate

Email Contact(s):
• Director: Bonnie Zare

Web Resource(s):
• Website
• Website for undergrad minor

Phone Number(s):
• *Main Office:*
540/231-6878

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Graduate Certificate in Women's and Gender Studies extends graduate students' work in other disciplines by exploring feminist theoretical perspectives and analyzing the structural and interpersonal dimensions of race, ethnicity, class, gender, and sexuality. Students complete nine hours of coursework together with a thesis or dissertation addressing an issue of gender, sexuality or other WGS topics in a significant way.

How to Apply:
Fill out the online application for participation in the certificate program.

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Women's & Gender Studies WGSC

Address:
507 McBryde Hall (0137), 225 Stanger St Virginia Tech
Blacksburg, VA 24061-0137

Contact this Certificate

Email Contact(s):
• Director: Bonnie Zare

Web Resource(s):
• Website
• Website for undergrad minor

Phone Number(s):
• *Main Office:* 540/231-6878

Admission Requirements

Graduate standing in primary discipline and director approval.

Course Requirements

The WGS Graduate Certificate requires 9 hours of coursework, including WGS 5914 Feminist Theory and WGS 5924 Feminist Research Methodologies. Other courses must be either WGS courses or WGS-approved from other disciplines. Thesis or dissertation must address gender, sexuality or other WGS topics and have at least one WGS faculty member or affiliate faculty member from other departments on the committee.

Additional Information

Please contact the WGS Director at bonzare@vt.edu to discuss the Program, course options, and graduate student activities.