GRADUATE CATALOG 2017-2018

Policies, Procedures, Academic Programs

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 http://www.hokiehandbook.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 http://www.co.vt.edu/Risk/studenthealthinsr/index.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 http://graduateschool.vt.edu/student-life/immigration-services/immigration-basics/visa-status.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. http://www.co.vt.edu/Risk/studenthealthinsr/index.html

MEDEX Overseas Evacuation Program

An overseas emergency evacuation program is available to faculty, staff, students and their families who travel overseas on university business. MEDEX provides emergency services outside your home country. Included are: locating appropriate medical care evaluation and close monitoring of treatment - management of emergency medical evacuation and transport of mortal remains coordination of direct claims payments to providers verification of your insurance to facilitate hospital admission continuous contact with family, physicians, and employer assistance with interrupted travel plans resulting from an emergency situation assistance replacing lost or stolen medications emergency message transmittal services emergency international transfer of funds assistance in locating lost or stolen documents or passports multilingual language services in emergency situations coordination centers and phone numbers throughout the world On Call International – A benefit of the Aetna Student Health Insurance plan Students 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 SMI@vt.edu. Students who are not enrolled in the VT student insurance plan may purchase MEDEX Travel assistance through Risk Management, phone: (540) 231-7439; e-mail: mikki@vt.edu. Students should purchase optional coverage prior to leaving the U.S.A. For more information or the link to the MEDEX application please visit the Risk Management website, http://www.co.vt.edu/Risk/Overseas.html

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 certificates of eligibility to apply for the appropriate visa, all international students must submit an Immigration Information Form. The following link provides the Immigration Information Form, Affidavit of Support, and Financial requirements and general instructions: https://graduateschool.vt.edu/student-life/immigration-services/new-student-guide.html. The Immigration Information Form collects (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 Graduate School. 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 550 on the paper-based test (PBT) or 80 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. 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 International Graduate Student Services office of the Graduate School at 540/231-8486, igss@vt.edu; 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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Application_Certificate.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. Up to 50% 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. 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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Application_for_Visiting_Graduate_Student-1.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.

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 Form (for obtaining Dual Status) (http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Accelerated_Undergraduate_Graduate_Status.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). 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 CGS&P policy for the 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. 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: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Graduate_Course_Withdrawal_(WG).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 (see dates on the Timetable for that semester). The 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 (see Timetable for date for that semester) 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 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 Graduate School 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 Status form http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Change_of_Degree_Status.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 Form http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/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. http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Change_of_Graduate_Program.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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Change_of_Campus.pdf International students in F1 or J1 status should consult with the international advisors in the Graduate School for the proper SEVIS changes.

Simultaneous Graduate Degrees

Students wishing to work toward two graduate degrees in different departments/programs should submit an Application for Simultaneous Degree Approval. http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/simultaneous_degree.pdf 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 http://graduateschool.vt.edu/student-life/immigration-services/employment/cooperative-education-program.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).

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).

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, or more than 6 per summer session) 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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Plan_of_Study_Change.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: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/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 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 by submission of a Plan of Study listing the proposed committee members. Committee Size and Composition Committee Size: Master's students must have an advisory committee of at least three faculty members with a Master's degree or higher. In some instances, it is appropriate to have fewer (minimum of 1) faculty members serving on the advisory committee for students earning a coursework-only degree (e.g., MBA). Departments offering coursework-only degrees can petition the Commission on Graduate Studies and Policies for approval to reduce the size of the committee. Doctoral candidates must have an Advisory Committee of at least four faculty members with a doctoral degree. Requests to expand an Advisory Committee by one member lacking these qualifications may be made to the Dean's office of the Graduate School. Graduate Advisors (Chairs of Advisory Committees) must be teaching/research faculty (full time, tenured or tenure track faculty at Virginia Tech, i.e., Graduate Program Faculty). A department may request that qualified non-tenure track faculty (e.g., Research or Clinical Professors, Professors of Practice, or Emeritus faculty who are research active) be approved as members of the Graduate Program Faculty of a department for purposes of having Co-chair privileges. Department heads/chairs or Graduate Program Directors may nominate such persons for Graduate Program Faculty status using the form at http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/graduate-committee-service-approval-form.pdf . If the Chair of an Advisory Committee leaves the university or retires during the student's degree, the department should consult with the Dean's Office of the Graduate School to determine the most appropriate continuing committee composition for advising of the student to degree completion. Committee members on Advisory Committees: Full time, tenure track, teaching/research faculty may serve on graduate committees throughout the university. Committee service by other qualified individuals, inside or outside the university may be requested by the department (see section below, Committee Service by Personnel Other Than Tenure Track Teaching/Research Faculty at Virginia Tech). The student should refer to the departmental policies and procedures document for any specific guidelines for graduate Advisory Committee service within the department/program. It is appropriate, but not required, that the Advisory Committee includes at least one faculty member from outside the student's major department. 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 may not serve as sole advisor of a dissertation or thesis committee for a student who is funded through a university sponsored project supported by the advisor's company, or for a student who is employed directly by the faculty member's company. The faculty member with the conflict may serve as co-chair or committee member. If another co-chair is appointed, that faculty member must be of equal or greater rank, must not be involved 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. See also Eligibility of Faculty/Staff for Graduate Degrees. Graduate students (including those VT employees who are pursuing graduate degrees) may not serve on a graduate Advisory and/or Examining Committee. Committee Service by Personnel Other Than Tenure Track Teaching/Research Faculty at Virginia Tech Committee Service by Personnel Other Than Tenure Track Teaching/Research Faculty at Virginia Tech: Personnel with suitable academic training and research experience who are not Virginia Tech full time, tenure track or tenured, teaching/research faculty, may be recommended for inclusion on a graduate student Advisory and/or Examining Committee. This category includes personnel from outside Virginia Tech, as well as Administrative/Professional Faculty, Instructors, Adjunct Faculty, Retired or Emeritus Faculty, and Staff at Virginia Tech. Such personnel must have a graduate degree at or above the degree being sought. Approval of the inclusion of such personnel is granted at the time the Plan of Study is approved by the Graduate School. If the person is on a temporary appointment there should be assurance that he/she will be available throughout the student's degree. These personnel may make up no more than one-third of the minimum committee membership, may share thesis/dissertation supervision responsibilities, and enjoy voting rights and privileges. Inclusion of committee members in these categories is requested by the student's Advisory Committee Chair and Graduate Program Director using the Graduate Program Faculty form http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/graduate-committee-service-approval-form.pdf . A curriculum vitae for the proposed committee member should be included with the form and the particular advantages of including this person on the committee should be cited. Once the registration form has been filed for an individual, a new form is not required for service on additional committees. Before submitting a registration request, check the list of approved Graduate Program Faculty and Additional Committee

Members at https://secure.graduateschool.vt.edu/apf.html 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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Change_of_Committee-Advisor.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.

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 : 1. Plagiarism and other violations of the Graduate Honor Code 2. 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 3. Ethical standards in teaching, mentoring, and professional activities 4. Available avenues for reporting alleged misconduct Additional topics, as relevant to the discipline : 1. Appropriate lab procedures and maintenance of lab notebooks and other research documentation 2. Fair use of publications, software, and equipment 3. Appropriate research protocols involving human and animal subjects; Institutional Review Board and/or Institutional Animal Care and Use Committee certification 4. Guidelines for maintenance of confidentiality (and, where relevant, anonymity) in research 5. Guidelines for determination of authorship 6. Appropriate grant and contract management, including appropriately asserting personal or program capacities and competencies when applying for grants and contracts 7. Discipline or fieldspecific professional ethics

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. 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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/simultaneous_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 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 three doctoral degrees: the Doctor of Philosophy (PhD), the Doctor of Education (EdD) and the Doctor of Veterinary Medicine (DVM). The PhD and EdD degrees are offered through the Graduate School and the DVM is offered through the College of Veterinary 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 graduate certificate can be double-counted across multiple graduate 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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Application_for_Degree_or_Certificate.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.

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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/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://secure.graduateschool.vt.edu/GSITWiki/Wiki.jsp?page=GAAPSETD

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/

Graduation

Procedures for Graduation

Students anticipating degree completion or certificate award must file an Application for Degree (AFD) form http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Application_for_Degree_or_Certificate.pdf or an Application For Certificate Conferral http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/GAAPforms/Application_for_Degree_or_Certificate.pdf to obtain a diploma or certificate and to have their names appear in the Commencement Bulletin. Submit two forms if receiving both a degree and a certificate. The AFD should be submitted electronically through Hokie SPA. Schedules 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.

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 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.

BIOMEDICAL AND VETERINARY SCIENCES

Professors: Virginia Buechner-Maxwell; Laura Hungerford; Thomas Inzana; Otto Lanz; David Lindsay; Xiang-Jin Meng; David Panciera; Robert Pleasant; Kerry Redican; John Rossmeisl; Nammalwar Sriranganathan; William Swecker; Jeffrey Wilcke; Anne Zajac;

Associate Professors: Jonathan Abbott; Michele Borgarelli; Christopher Byron; Sherrie Clark-Deener; Linda Dahlgren; Julia Gohlke; Piedad Henao Guerrero; Ian Herring; Kathryn Hosig; William Huckle; Bradley Klein; William Scarratt; Sharon Witonsky; Lijuan Yuan;

Assistant Professors: Irving Allen; Andrew Allison; Andrea Bertke; Clayton Caswell; Nikolaos Dervisis; David Grant;

Associate Professor of Practice: Susan Marmagas;

Graduate Contact: cvmgrad@vt.edu

Biomedical & Veterinary Sciences: http://www.vetmed.vt.edu/academics/bmvs/

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 our program is to provide the students with a sound background in the basic and clinical sciences and to cultivate the ability to apply rigorous scientific thinking to advanced biomedical and veterinary 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.

Center for Molecular Medicine and Infectious Diseases (CMMID)

Flow Cytometry

Glassware/Media Preparation

Morphology

Physiology and Clinical Research

Quality Assurance Unit

Study Design and Statistics

Toxicology

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, Leesburg)

TOEFL

Paper: (570.0)

Computer: (230.0)

iBT: (90.0)

GRE

Verbal and Quantitative : Combined Score (1070.0), New GRE Test Scale Combined Score (300.0)

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

Paper: (570.0)

Computer: (230.0)

iBT: (90.0)

GRE

Verbal and Quantitative : Combined Score (1070.0), New GRE Test Scale Combined Scores (300.0)

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 8114):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5006 (VM 9086):

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 inteval. 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 (VM 8064):

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. I

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5094 (FST 5094) (CHEM 5094):

Grant Writing and Ethics

A framework for writing clear, concise grant proposals in a team-oriented, multicisciplinary 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5124 (VM 8474):

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. I

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

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

Corequisite(s):

BMVS 5144:

Oncology Pathology

This course presents the pathology of neoplasms of all organ systems by using assigned reading, tutorials, tissue sections and discussion. Emphasis is on the clinical presentation, histologic diagnosis, and prognosis of each neoplasm. Formal lectures are not given. Independent study and twice weekly discussion sessions. DVM degree required. II

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): VMS 5134 (UG) OR VMS 5134

Corequisite(s):

BMVS 5154G:

Advanced Lab Animal Management

Advanced course involves a study of the principles of laboratory animal science, providing the student with a basic understanding of the laws and regulations governing the care and use of research animals, husbandry and surgery of a variety of lab animal species, and variables which can adversely affect animal research. Through formal lectures, discussions, and laboratory sessions, this course is designed to complement graduate studies in biological, biomedical, and life sciences which involved the use of animals in research. Graduate standing required.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

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

BMVS 5305:

Veterinary Oncology

These companion courses are designed to provide intensive study of the biology of neoplasms, their diagnosis, clinical presentation and treatment. 5305: Introductory/review lectures: factors in protooncogene mutation, methods of diagnosis, and cancer epidemiology. A second portion of this course discusses important neoplasms of various animal

species and body systems, and classical methods of treatment. 5306: In-depth discussion of cancer chemotherapy, immunotherapy, and new advances in therapy such as gene replacement/modification. Pre: third-year standing in the DVM curriculum.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture
Instruction Type(s): 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 metabloism, sensory systems, learning, mental disorders, and neuropharmacological agents.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): (BCHM 4116 (UG) OR BCHM 5124 (UG)) OR (BCHM 4116 OR BCHM 5124)
Corequisite(s):

BMVS 5364:
Ultrastructure Methodology in Biological Sciences
An introduction to the methodology of transmission electron microscopy as it applies to the life sciences. The goal of the course is to provide students who expect to use ultrastructure as a research tool with the fundamental principles behind the techniques, and hands-on experience in preparing and examining them in the electron microscope. Students prepare tissues and will generate a final project in the form of a journal article. Because of the intensive nature of the laboratory portion, course enrollment is limited to 15 students, and permission of the instructor is required.
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, Lecture
Prerequisite(s): BIOL 4504 (UG) OR BIOL 4504
Corequisite(s):

BMVS 5444 (VM 8114):
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. II
Credit Hour(s): 0 OR 4
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, Lecture
Prerequisite(s): VM 8014 OR BMVS 5434 (UG) OR BMVS 5434
Corequisite(s):

BMVS 5454 (VM 8034):
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. I
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, Lecture
Prerequisite(s):
Corequisite(s):

BMVS 5464 (VM 8134):
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. II
Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

BMVS 5474 (VM 8104):
Veterinary Neurobiology
Normal structure and function of the mammalian nervous system. Basic neuroanatomy, neurophysiology, neurochemistry, and neurohistology of sensory, motor, integrative, and regulatory systems will be discussed, as well as metabolic support systems. II
Credit Hour(s): 0 OR 2
Lecture Hour(s): 0 OR 4
Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5604:

Principles and Methods in Equine Surgery

Graduate level course in advanced techniques in equine surgery. Activities include elucidation of pathophysiology, diagnosis, and surgical approach to complex equine conditions including nonroutine cases as they are presented. DVM degree required. Maximum 3 credits.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5614:

Principles and Methods in Equine Internal Medicine

Graduate level course in the application of advanced techniques in equine internal medicine. Activities will include elucidation of pathophysiology, performance of diagnostic methodology, and therapeutic management of complex medical disorders affecting the equine species. Course will be offered at the Marion duPont Scott Equine Medical Center. DVM Degree required. I,II,III

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5704 (VM 8704):

Veterinary Cytopathology

Interpretation of cytopathologic samples. Descriptive reports. Routinne to complex case material from animal tissue specimens. Pre-requisite: Third year standing in the DVM curriculum.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5714:

Biomedical Literature

This course deals with searching the literature in Biomedicine, both in printed form as well as computerized bibliographic databases. It also covers the topic of managing personal collection of published materials for effective retrieval. This course is for graduate students enrolled in biomedical research programs.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5734:

Clinical Pathology

The study of relating abnormal clinical laboratory data to specific organ dysfunctions or lesions with emphasis on data interpretation and on understanding the pathophysiologic mechanisms leading to abnormal data. Additional emphasis will be placed on understanding the diagnostic and prognostic value of thoughtfully selecting pertinent laboratory tests to aid in the medical management of clinical cases. Alterations in the hematology, clinical chemistry, urinalysis, and cytology of the major domestic species will be studied.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5744 (VM 8324):

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

Instruction Type(s): Lab, 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

Instruction Type(s): 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: Instructor's approval required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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 group's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5824:

Small Animal Nutrition

Practical feeding guidelines for companion animals. Special consideration also given to the relationship of diet to nutrient excesses and deficiencies that result in clinical disorders. Diagnosis, treatment, and prevention of metabolic disorders of companion animals will be discussed.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5834:

Food Animal Nutrition

Practical feeding guidelines for food animals. Special consideration also given to the relationship of diet to nutrient excesses and deficiencies that result in clinical disorders. Diagnosis, treatment, and prevention of metabolic disorders of food animals will be discussed.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): VM 8454

Corequisite(s):

BMVS 5844:

Equine Nutrition

The course is designed to provide practical feeding guidelines for different classes of horses. The relationship between nutrition and clinical disorders of the horse is explored including their nutritional management. Students will be expected to complete a problem-solving nutrition project during the course.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): VM 8454

Corequisite(s):

BMVS 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5904:

Project and Report

NONE

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. I,II,III

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5974:

Independent Study

NONE

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):

BMVS 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): 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 student's 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

BMVS 6094:

Board Certification Topics

Structured preparation for the specialty examinations associated with residency programs and board cerification. 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
Instruction Type(s): 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. (3H,3C)
Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): TBMH 5004 OR BIOL 5884

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. II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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 isntructor. May be repeated to a maximum of 18 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 6564 (VM 9094):

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMVS 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BUSINESS, ACCOUNTING AND INFORMATION SYSTEMS

John Maher, Head

Professors: Reza Barkhi; France Belanger; John Maher; Wilmer Seago; Steven Sheetz;

Associate Professors: Ling Lisic; Debra Salbador; David Tegarden; Linda Wallace;

Assistant Professors: Matthew Cobabe; Robert Davidson; Matthew Erickson; Michelle Harding; Sean Hillison; Jingjing Huang; Eugene Johnson; Sarah Stein; Michael Wolfe;

Visiting Faculty: Jeffrey Pittman;

R. B. Pamplin Professor: France Belanger;

KPMG Professor: Reza Barkhi;

John F. Carroll, Jr. Professor: John Maher;

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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

–

DEGREES OFFERED

MACIS Degree

Offered In (Blacksburg)

TOEFL

IBT: (105.0), (0.0)

Computer: (260.0)

iBT: (105.0)

GMAT

: Total (520.0)

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 and information systems. It is especially appropriate for those individuals planning to become a CPA 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 in 12 months of coursework. Students without prior collegiate studies in accounting, information systems, and/or business administration can expect to spend additional time in the Program completing prerequisites. No more than one grade of C and no grades less than C may be earned by candidates for graduate degrees (this excludes undergraduate prerequisites). A second grade of C or lower, will result in dismissal from the Program, absent extenuating circumstances approved by the student's course advisor and the department head.The MACIS Program has four different options designed to prepare students for different types of careers (Audit, Tax, Financial Services and Information Systems). Audit prepares students to effectively practice as accountants or auditors within a company or public accounting firm, ranging in size from small to Fortune 500 companies and other large entities. Tax prepares students to provide tax return preparation and consultation 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 he/she 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 or in the information technology department within a company. Courses generally offered include: ACIS 5014 Information Systems Audit and Control 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 5444 Forensic & Investigative Accounting ACIS 5514 Management of Information Systems ACIS 5524 Advanced Database Management Systems ACIS 5534 Information Systems Development ACIS 5584 Information Systems Security and Assurance ACIS 5594 Web-Based Applications and Electronic Commerce FIN 4264 Managing Risk with Derivatives FIN 5124 Investment Analysis/Portfolio Management FIN 5194 Commercial Law MGT 5384 Ethical Dimensions of Leadership

PhD Degree

Offered In (Blacksburg)

GMAT

: Total (640.0)

TOEFL

Paper: (650.0)

iBT: (115.0)

The program leading to the Ph.D. in business with a concentration in accounting and information systems 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/or information systems and research methods, as well as course work in a supporting area and statistics. The remainder of the time is devoted to the dissertation. There is no foreign language requirement, although computer proficiency is expected. The supporting area can be chosen from among the field options within the Pamplin College of Business or in an area outside the college, subject to approval by the student's advisory committee. 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, additional ACIS courses may be required. Each candidate for the Ph.D. in business with a major in accounting and information systems must pass the 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

Instruction Type(s): Lecture

Prerequisite(s): ACIS 3414 (UG) OR ACIS 3116 (UG) OR ACIS 3515 (UG) OR ACIS 3504 (UG) OR ACIS 3414 OR ACIS 3116 OR ACIS 3515 OR ACIS 3504

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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.

Indentification and evaluation of alternative concepts and models will also be emphasized.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): ACIS 3115 (UG) OR ACIS 3115
Corequisite(s):

ACIS 5134:

Mergers and Acquisitions

In-depth analysis of business mergers and acquisitions, including variable interest entities, multiple entity accounting, foreign currency transactions and financial statement translation and remeasurement; worldwide accounting diversity; and current issues in accounting. 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 4114 (UG) OR ACIS 4114
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

A comprehensive treatment of the analysis of financial statements as an aid to decision making. Primary attention is placed on investing and lending decisions as they affect the financial manager.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): ACIS 5104 OR ACIS 2115 (UG) OR ACIS 2115
Corequisite(s):

ACIS 5214:

Advanced Strategic Cost Management

To provide an understanding of advanced strategic cost management methods. The areas covered include topics in cost estimation, cost-volume-profit analysis, activity based costing, costing in new manufacturing environments, performance measurement, management control, and ethical implications. Graduate Standing Required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): ACIS 4214 (UG) OR ACIS 4214
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
Instruction Type(s): Lecture
Prerequisite(s): ACIS 5104 OR ACIS 2116 (UG) OR ACIS 2116
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

Instruction Type(s): Lecture

Prerequisite(s): ACIS 4314 (UG) OR ACIS 4314

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

Instruction Type(s): Lecture

Prerequisite(s): ACIS 4314 (UG) OR ACIS 4314

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

Instruction Type(s): 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ACIS 4314 (UG) OR ACIS 4314

Corequisite(s):

ACIS 5414:

Auditing Theory

An in-depth study of the auditing profession. Topics include professional standards, independence, business and risk analysis, regulation of the profession, and advanced reporting issues. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ACIS 4414 (UG) OR ACIS 4414

Corequisite(s):

ACIS 5424:

Accounting and Information Systems

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): null null

Corequisite(s):

ACIS 5444:

Forensic and Investigative Accounting

Forensic Accounting is a specialized area of accounting which uses accouning methods and finacial techniques to assist in solveing 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 managment, fraud investigation, and the related audit tools. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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 4514 (UG) OR ACIS 4514 OR ACIS 4515 (UG) OR ACIS 4515 OR ACIS 5504

Corequisite(s):

ACIS 5534:

Information Systems 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 nonexecutable models and executable computer prototypesis. Must have prerequisites or 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): ACIS 4514 (UG) OR ACIS 4514 OR ACIS 4515 (UG) OR ACIS 4515 OR ACIS 5504

Corequisite(s):

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):

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ACIS 5974:

Independent Study

NONE

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):

ACIS 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): ACIS 6004 (UG) OR ACIS 6004

Corequisite(s):

ACIS 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BUSINESS ADMINISTRATION

Parviz Ghandforoush, Head

Professors: Sudip Bhattacharjee; Dipankar Chakravarti; Parviz Ghandforoush; Mahmood Khan; Raman Kumar; Sattar Mansi; Cliff Ragsdale;

Associate Professors: Wade Baker; William Becker; Donald Hatfield; Barbara Hoopes; Tabitha James; Raymond Major; Quinton Nottingham;

Assistant Professors: Anne-Sophie Chaxel;

Visiting Faculty: David Simpson;

General Contact: mba@vt.edu

General Contact: cbia.pamplin@vt.edu

General Contact: htmdpt@vt.edu

Graduate Programs: http://www.mba.vt.edu

Program Site: http://cbia.pamplin.vt.edu

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 the National Capital Region and other locations in Virginia. The Master of Business Administration (MBA) degree program has three program formats (options): Evening (part- or full-time) based in Falls Church, Executive with classes in Arlington, and, Professional with cohorts meeting in Roanoke and Richmond. 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). Masters of Science in Business Administration (MSBA) with a concentration in Hospitality and Tourism Management is offered primarily at our National Capital Region Campus in Falls Church, Virginia but with availability via online capabilities on our Blacksburg campus. Masters 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 National Capital Region 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 MBA in the NCR has program options in Falls Church and Arlington Centers. MBSA-Hospitality and Tourism Management classes are taught in the Falls Church location. Commonwealth Campus Centers The Professional MBA is taught at the Richmond and the Roanoke Centers. Pamplin Hall The MSBA-Business Analytics courses are taught on the main campus in Blacksburg at Pamplin Hall.

Falls Church, Arlington and Richmond, Roanoke Centers

The Graduate Programs offices are housed in the Falls Church Center, 7054 Haycock Road, just across from the West Falls Church metro station, and near Rt.s 7, I-66 and I-495. The Evening MBA program holds classes at the Northern Virginia Center in Falls Church. The Executive MBA program holds classes at the Virginia Tech Arlington Center at 900 N. Glebe Road, near the Ballston stop of the metro and off I-66. Professional MBA courses are held at the Richmond and Roanoke Virginia Tech centers in alternating months.MBSA-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 at Blacksburg in Pamplin Hall: httpBAs://www.vt.edu/about/buildings/pamplin-hall.html

DEGREES OFFERED

MBA Degree

Offered In (Roanoke, Richmond, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal (154.0), Quantitative (154.0)

GMAT

: Total (600.0)

Three program options (formats) of EvMBA, EMBA and PMBA. Completion of 48 credit hours of coursework, 3.0 undergraduate GPA, GMAT/GRE for EvMBA, and PMBA programs. Evening MBA - flexible part- or full-time program, classes in the evening, fall and spring start. Located in Falls Church, VA. www.MBA.vt.eduExecutive MBA - cohort based, classes on alternating weekends, fall start only. Located in Arlington, VA. www.MBA.vt.eduProfessional MBA - cohort based, one weekend/month classes, fall start only. Located in Richmond and Roanoke, VA. www.MBA.vt.edu

Degree Concentrations:

Available in the Evening MBA program

Business Intelligence/Analytics, Entrepreneurial Leadership, Financial Management, Global Business,Information Technology Management, Organizational & Leadership Management, Hospitality & Tourism Management, Dual degree option with Master of Information Technology degree

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (550.0)

iBT: (80.0)

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. Website: 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 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. http://www.htm.pamplin.vt.edu/

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. The application process includes the following: Online application, including transcripts and test scores (GRE or GMAT and TOEFL or IELTS scores for international students) Personal essays Two letters of recommendation Applicant interview 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.

Hospitality and Tourism Management

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 program is designed to allow students to pursue both the MSBA and more specialized certifications 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 has the ability to 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

BUSINESS, BUSINESS INFORMATION TECHNOLOGY

Roberta Russell, Head

Professors: Ralph Badinelli; Parviz Ghandforoush; Cliff Ragsdale; Terry Rakes; Loren Rees; Roberta Russell; Bernard Taylor; Christopher Zobel;

Associate Professors: Alan Abrahams; Jason Deane; Barbara Hoopes; Tabitha James; Lara Khansa; Raymond Major; Lance Matheson; Quinton Nottingham; Onur Seref; Alan Wang;

Assistant Professors: Wenqi Shen;

Ralph Medinger Lenz Professor: Ralph Badinelli;

Bank of America Professor: Cliff Ragsdale;

William C. and Alix C. Houchens Professor: Terry Rakes;

Arthur Andersen Professor: Loren Rees;

R.B. Pamplin Professor: Bernard Taylor; Christopher Zobel;

Graduate Contact: cliff.ragsdale@vt.edu

Graduate Site: http://bit.vt.edu/academics/graduate-programs0.html

The PhD in Business with a concentration in Business Information Technology is designed to be a full-time, four-year, residential program offering specialized study in information technology, business analytics, decision support systems, and operations and supply chain management. Although the program emphasizes the study of technologies used in the creation, storage, exchange, analysis, and use of information in its various forms, considerable emphasis is also placed on the related disciplines of mathematical optimization, stochastic processes, computer simulation, artificial intelligence, data science and statistics. Study of these topics requires that the student have a strong background in mathematics and computing. The primary goal of the program is to prepare graduate students for successful academic careers. This objective is realized through a flexible, research-oriented program of study that provides extensive interaction with a faculty of outstanding researchers and teachers.

SPECIAL FACILITIES

The Department of Business Information Technology is located in Pamplin Hall.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Computer: (225.0)

iBT: (100.0)

Paper: (550.0)

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 university's 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 GMAT exam. There is no minimum required GMAT score, but full GMAT exam results must be provided. 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. 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. A minimum of 12 hours of graduate course work must be taken in the Department of Business Information Technology.2. A minimum of nine hours of research methodology related course work must be completed.3. 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.4. Successful completion of departmental screening exams at the end of the first and second years of study. 5. Full instructional responsibility for a least one course during doctoral studies, subject to departmental needs. 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. In formulating the program, attention is given to the candidate's prior academic preparation and career objectives. Typically, a significant number of credits are taken outside the Pamplin College of Business in the departments of computer science, electrical and computer engineering, industrial systems engineering, statistics, or others as needed.

GRADUATE COURSES (BIT)

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 decison 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 instructor's consent. 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):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIT 5495:

Decision Support Systems Design and Implementation

Study of the design and implementation of decision support systems (DSS) using a visual environment. Topics will include methods for data access, modeling and computation in a visual language, graphical display of support material and report generation methodologies, object sharing between software components, and the deployment of support systems within distributed environments. Distributed DSS topics will include client server systems, common object model methodologies, and distribution in a web-based environment.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): BIT 5474 (UG) OR BIT 5474

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 5594:

Web-Based 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. Must have completed the first year of the MBA program or the prerequisites to the Master of Accountancy.

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIT 5654:

Project Management

This course introduces the fundamentals of project management, beginning with project defintion 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 throughtout 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

Instruction Type(s): 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

Instruction Type(s): 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 methodoogy. 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

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIT 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIT 5974:

Independent Study

NONE

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):

BIT 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIT 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BUSINESS, FINANCE

John Easterwood, Interim Head

Professors: Gregory Kadlec; Arthur Keown; Raman Kumar; Ruth Lytton; Sattar Mansi; George Morgan; Douglas Patterson; Vijay Singal;

Associate Professors: Randall Billingsley; John Easterwood; Jin Xu;

Assistant Professors: Andrew MacKinlay; Bradley Paye; Pengfei Ye;

Professor of Practice: Michael Kender;

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;

Graduate Contact: zarabeth@vt.edu

Graduate Site: http://www.finance.pamplin.vt.edu

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 three 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 an 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 http://www.finance.pamplin.vt.edu/program/.

SPECIAL FACILITIES

The Finance department is located in Pamplin Hall with the main department office at 1016 Pamplin.

_Finance Facilities Introduction

The Finance department is located in Pamplin Hall with the main department office at 1016 Pamplin.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)

GMAT

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)

Students admitted into the program are required to have a master's degree, competitive GMAT scores, strong transcripts and letters of recommendation. The 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. 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. In the summer following the four semesters of course work students are required to pass a 2-day comprehensive exam in Corporate Finance and Investments. For the rest of their time in the program they work on their dissertation under the guidance of a dissertation chair and committee.

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 firm's 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

Instruction Type(s): Lecture

Prerequisite(s): BIT 5724, FIN 5084, ACIS 5104

Corequisite(s):

FIN 5074:

Interest Rates

Analysis of the macroeconomic and macro-financial environment of interest rate determination. Attention will be paid to the role of both monetary policy and market forces. The course will also review and analyze the basic determinants of valuing fixed income instruments.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): FIN 5024

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 firm's 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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 dinomial 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 firm's 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
Instruction Type(s): Lecture
Prerequisite(s): FIN 5024
Corequisite(s):

FIN 5194:

Commerical Law and Professional Liability

Study of the Uniform Commerical 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
Instruction Type(s): Lecture
Prerequisite(s): FIN 3055 (UG) OR FIN 3054 (UG) OR FIN 3074 (UG)
Corequisite(s):

FIN 5214:

Fixed Income Securities

Description and analysis of several classes of fixed income securities. Measurement, management, and pricing of interest rate risk and credit risk. Valuation of embedded options.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): FIN 5054, FIN 5074
Corequisite(s):

FIN 5264:

Mergers and Acquisitions and Corporate Restructuring

Focuses on the major aspects of merger and acquisition transactions: deal strategy, deal analysis and deal design. Additionally, it explores value creation through other forms of corporate restructuring, such as divestitures or sell-offs, spin-offs, equity carve-outs, leveraged recapitalizations and leveraged buyouts. The course uses the case methods as the primary mode for teaching.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): FIN 5044, FIN 5064
Corequisite(s):

FIN 5284:

Free Markets, Individual Freedom, and Social Welfare

Expose students to the various viewpoints on the role that free markets can and do play in promoting individual freedoms and enhancing social welfare. This course will explore the strengths and weaknesses of capitalism by critically evaluating the relationship between the economic efficiency achieved by capitalism and the attainment of social welfare objectives. The course will also examine the economic and social welfare implications of current issues that could include globalization, price controls, income inequality, outsourcing, corporate pricing power through monopoly/oligopoly, and government regulation of the economy. 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 5604:

Financial and Economic Environment of Business

Provide an understanding of the principles that affect a firm's interactions with its customers, suppliers, competitors, employees, and other organizations, and the roles of menetary 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
Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): FIN 5654

Corequisite(s):

FIN 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FIN 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FIN 5974:

Independent Study

NONE

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):

FIN 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FIN 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): FIN 6004

Corequisite(s):

FIN 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FIN 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BUSINESS, HOSPITALITY AND TOURISM MANAGEMENT

Nancy McGehee, Head

Professors: Mahmood Khan; Nancy McGehee; Juan Nicolau Gonzalbez; Richard Perdue;

Associate Professors: Manisha Singal; Zheng Xiang;

Assistant Professors: Hee Jung Kang; Eojina Kim;

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Graduate Contact: mahmood@vt.edu

HTM Departmental Website: http://www.htm.pamplin.vt.edu/graduate/index.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

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 4 times 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 A written qualifying examination for all Ph.D. candidates will be conducted at the end of the first year of coursework. This exam will typically be given on the first Monday and Wednesday in June. The exact dates for each year will be announced by the department no later than January 1. Students will be required to respond to question(s) in the following three sections:1.	Methodology and Statistics2.	Theory Development3.	HTM Body of Knowledge The Graduate Program coordinator will request all tenure track faculty to submit questions and a grading rubric for the exam and will compile the qualifying examination based on the input. The Graduate Program Coordinator will work with the graduate faculty to ensure the inclusion of questions that measure the appropriate level of student knowledge and expertise in each of the exam areas. To facilitate the grading process, the faculty member providing a question will also provide a general rubric for grading of the student responses. The Graduate Program Coordinator will contact faculty for questions at least one month in advance of the exam. Students will sit for the exam in the designated exam room in the HTM department. The examination will be given to students in three sections. The first day of the qualifying exam will commence at 9:00 am and conclude at 1:30 pm typically on the first Monday in June and will include two sections: Methodology and Statistics (Section I) and Theory Development (Section II). The second day of the exam will commence at 9:00 am and conclude at 1:30 pm typically on the first Wednesday in June and will focus on the HTM Body of Knowledge (Section III). Students will NOT be permitted to use a personal computer during the exam period; a laptop computer will be provided by the Department for the exams. Preliminary Examination This examination is designed to determine the candidate's ability to progress into the research 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 Examination2.	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 members2.	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. 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 SpecializationOffered 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 OrganizationsBIT 5594 Web Applications and E-Commerce International Hospitality and Tourism Strategy SpecializationOffered 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 ManagementMGT 5794 Strategic ManagementMKTG 5704 International Marketing Strategy Entrepreneurship in Hospitality and Tourism Management SpecializationOffered during the Spring semester, 9 hours Required: MGT 5814 Entrepreneurial Leadership Choose two courses from the following: HTM 5424 Human Resource ManagementHTM 5464 Franchising in Hospitality Management HTM 5444 Financial Management in the Hospitality Service Industries TOTAL HOURS REQUIRED FOR M.S.B.A. DEGREE: 30 HOURSTime 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 5544:

Research Methods for Hospitality Applications

The use of business research methods in the scientific investigation of hospitality related problems. The foundations of research, research design, data collection techniques, sampling issues, statistical techniques and the analysis and reporting of data will be studied.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5634

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HTM 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HTM 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HTM 5964:

Field Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HTM 5974:

Independent Study

NONE

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):

HTM 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): HTM 5544
Corequisite(s):

HTM 6534:
Advanced Seminar in Strategic Management in the Hospitality Industry
This seminar is designed to provide an in depth exploration of the literature and research which has been developing in the context of the hospitality and tourism industry, specifically as it applies to the hotel, restaurant, and tourism sectors. Specific methodological approaches encountered in an industry specific environment will be identified and evaluated. The current state of theory development will be assessed and key issues relevant to further theory building will be explored. The course will be in a seminar format where students will be expected to develop a comprehensive and in-depth understanding of the body of knowledge relative to strategy in the hospitality and tourism industry. Must have the prerequisite or equivalent.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): HTM 5534
Corequisite(s):

HTM 6974:
Independent Study
NONE
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):

HTM 6984:
Special Study
NONE
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

BUSINESS, MANAGEMENT

Devi Gnyawali, Head

Professors: Devi Gnyawali; Steven Markham; Anju Seth; Richard Wokutch;
Associate Professors: Jeffrey Arthur; Daniel Beal; William Becker; Donald Hatfield; Linda Tegarden; Ryan Zimmerman;
Assistant Professors: Richard Hunt; Phillip Thompson; David Townsend; Anna Ward Bartlett;
Pamplin Professor: Devi Gnyawali; Anju Seth; Richard Wokutch;
Digges Professor: Steven Markham;

Graduate Program: segiles@vt.edu

Graduate Program Director: dbeal@vt.edu

Graduate Site: http://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 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 in order 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' graduation 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

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 5404:

MBA Career Planning

This course is designed to improve career success and satisfaction of MBA students. Students use the Success-Related Observable Behaviors Model (SROB) to identify behaviors that are critical to their chosen career roles. Students assess their mastery of those behaviors with which to improve the effectiveness of their career search through changed behaviors or changed objectives. Strategies for developing networkds of individuals and organizations are covered. Assignments emphasize a progressive process for creating a features profile that differentiates the student's self-promotion from that of competitors. MBA students only. Must be enrolled in first semester MBA core courses.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 5454:

International Business

Challenges and opportunities for multinational corporations the the global economy. Sociocultural, economic, political, and legal environments of international business. Strategies for creating competitive advantage globally. Analytic and managerial skills for international business functions. Pre-requsite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 5464:

Corporate Acquisitioins and Alliances

Modes to accomplish the firm's corporate strategy and create corporate advantage, including mergers, acquisitions, alliances, joint ventures and corporate restructuring. Analytic and managerial skills for managing corporate development in traditional, large business settings in developed economies as well as in start-ups, the Internet/new economy and emerging economies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MGT 5314

Corequisite(s):

MGT 5594:

Technology and Innovation Management

This course takes a general manager's 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
Instruction Type(s): 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 organizatioons where significant diversity is present. Executive MBA students only.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

MGT 5634:

Strategic Business Environment

Course focuses on tools and techniques for industry and compeitive 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

MGT 5654:

Strategic Human Resource Management

Examines current issues critical to the management of an organization's human capital assets. Critically examines how systems of human resource policies and practices can be used to enhance a firm's 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): MGT 5314
Corequisite(s):

MGT 5794:

Strategic Management

Examines business policy through a study of general management's 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. I,II,III.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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 firm's 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

MGT 5844:

Business & Corporate Strategy

Focuse 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 ina variety of industries, both domestic and international. Pre-requisite: Enrollment in Executive MBA program.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 5854:

Ethics and Leadership in a Global Environment

Ethical issues in business and management using both a theorethical and a case study approach. Relevance of philsophical 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

NONE

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 5964:

Field Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 5974:

Independent Study

NONE

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):

MGT 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MGT 6104:

Advanced Research Studies

Students will carry out a theoretical or empirical research project, produce a research paper, present the research findings to the departmental faculty and students, and submit the manuscript for presentation at a professional meeting or for publication in an academic journal. Pre: Six hours of graduate statistics, completion of the first year of the management doctoral program.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 6724:

Review of Strategic Managment & Organizational Theory Research

Current research in strategic management and organizational theory will be examined. Students will assess fundamental research questions, opportunities, and limitations of this research. Current research methods in strategic management and organization theory will be discussed and examined. Pre-requisite: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MGT 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BUSINESS, MARKETING

Paul Herr, Head

Professors: David Brinberg; Dipankar Chakravarti; Paul Herr; Mack Sirgy;

Associate Professors: Eloise Coupey; Mario Pandelaere;

Assistant Professors: Anne-Sophie Chaxel; Juncai Jiang;

Visiting Faculty: Jill Sundie;

Robert O. Goodykoontz Professor of Marketing: David Brinberg;

Professor of Real Estate: Mack Sirgy;

Virginia-Carolinas Professor of Purchasing Management: Paul Herr;

Sonny Merryman Inc. Professorship: Dipankar Chakravarti;

Graduate Programs Coordinator: llsharp@vt.edu

Graduate Site: https://marketing.pamplin.vt.edu/prospective-students/prospective-phd.html

Doctoral Program in Marketing:

http://www.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 PhD in Business with Concentration in Marketing focused on basic research in marketing. For students interested in careers in marketing management, information is available on the Marketing website: www.marketing.pamplin.vt.edu. For those interested in the MBA program, information is available at http://www.mba.vt.edu. M.S. OverviewThe Marketing Department offers a Master of Science in Business with Concentration in Marketing focused on advanced marketing research. The program serves students with two types of interests:1. Students who wish to pursue a Ph.D. but who have completed only an undergraduate degree. 2. Students with well defined interests in analytical positions in marketing research, advertising research, and marketing analytics. The program is highly selective and limited in size (admitting 1 to 3 students per year) and involves a high level of interaction with members of the marketing faculty. For students seeking to pursue a Ph.D., 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. For students who choose to treat the M.S. degree as terminal, significant employment opportunities exist in marketing research and advertising research organizations as well as companies with strong business analytics groups. However, prospective applicants should understand that this program is not a substitute for the M.B.A. for students seeking a professional business degree. The M.S. program provides focused and advanced technical training not available in the M.B.A. program of study and its requirements are quite different from the MBA. PhD OverviewThe 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, INFORMS, and the Academy 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.

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

The Department of Marketing Office is located in 2016 Pamplin Hall.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

M.S. Degree Requirements The program of study includes a minimum of 30 credit hours of coursework at the graduate level, plus a comprehensive project, examination, or a thesis. The degree requirements include:- 9-12 credit hours of advanced marketing seminars (6000 level). - A minimum of 9 credit hours of research methods and statistics courses at the graduate level. Suggested courses include graduate study in statistics (STAT 5615, 5616, or 5004) econometrics (ECON 5125, 5126, 5127), Psychology (PSYC 5315, 5316), and/or Marketing (MKTG 6224). - 6-9 elective credit hours at the graduate level in a related discipline (e.g., psychology or economics) or graduate level business courses (if the student has the requisite background and space permits) 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. Up to 6 credit hours will be awarded for the thesis.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Ph.D. Requirements The program of study includes a minimum of 30 credit hours of coursework at the graduate level, plus a comprehensive project, examination, or a thesis. The degree requirements include:PhD Degree RequirementsThe program is designed as a four-year program with a strong research focus on behavioral marketing research areas including consumer research, consumer health and welfare, public policy, marketing strategy, and research methodology. The doctoral program, administered by the Graduate Program Committee in the Department of Marketing and the Graduate School of Virginia Tech, requires coursework in marketing content and theory, statistics, research methodology, and one supporting minor. The minor should be consistent with the student's interests and professional goals. Commonly selected minors include psychology, sociology, management, management science, and statistics. The program, in its entirety, is designed to train students to conceptualize, design and execute research; to analyze data; and to disseminate knowledge to peers, students, and practitioners.A series of marketing doctoral seminars are required during the first year of study. MKTG 6105, 6106, and 6304 focused on the marketing literature and current issues in academic research in the field. MKTG 6224 is oriented to research methods. Additional seminars may be offered for the benefit of doctoral students. In addition, at least two courses of graduate statistics must be taken beyond STAT 5615 and 5616 or equivalent, along with at least three courses in the chosen minor field. 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. 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 take a qualifying examination building on the work completed to date. Students failing the qualifying examination will be asked to leave the doctoral program. In addition to study of the marketing literature, 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 members of the faculty, to major conferences and later to marketing journals. In addition to the departmental qualifying examination, students are required during their third year of study to develop a dissertation proposal and to defend it. This defense constitutes the University-required Prelminary Examination. The fourth year of the doctoral program is focused on 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

Instruction Type(s): Lecture

Prerequisite(s): MKTG 5104

Corequisite(s):

MKTG 5254:

Product Strategy

Strategic product planning and new product development within the context of marketing. Topics include the role of the product manager, strategic marketing planning, product/market identification, new product development, and diffusion of innovations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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 capiitalist enterprise as well as the role of marketing and entrepreneurship in advanceing 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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 orgainizations, 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5664:

Managing MKTG Relationships

Factors that infulence development of professional relationships necessary to create long-term satisfaction and commitment to the firm and its services. Integrates research and best practices in professional services with concepts of relationship marketing to provide practical knowledge of how to develop the network of relationships, both internal (e.g., staff) and external (e.g., customers, suppliers, investors, media) needed to develop a sustainable supply of goods and services.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MKTG 5654

Corequisite(s):

MKTG 5674:

Marketing in Dynamic Contexts

Strategic decision amking 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 entreprise, as well as the role of marketing and entrepreneurship in advancing social wlefare and economic development. Multi-disciplinary approache 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): MKTG 5104

Corequisite(s):

MKTG 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MKTG 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MKTG 5974:

Independent Study

NONE

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):

MKTG 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): 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 decison 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 6224:

Advanced Marketing Research

Issues related to research design, measurement and scaling, and data collection procedures. Methods for doing integrative research reviews are also covered. Six hours of graduate statistics required. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MKTG 5154, MKTG 6214

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

Instruction Type(s): Lecture

Prerequisite(s): MKTG 5154

Corequisite(s):

MKTG 6404:

Advanced Quantitative Marketing Methods

Theory, method, and application of selected quantitative methods for marketing: linear structural relations, path analysis, canonical and discriminant analysis, and exploratory and confirmatory factor analysis. Special purpose methods such as conjoint analysis, multidimensional scaling, cluster analysis, and recent methodological developments also will be covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MKTG 5154

Corequisite(s):

MKTG 6444:

Seminar in Marketing & Society

The role of marketing in society from the standpoint of consumer welfare, including ethical considerations, economic analyses of consumer welfare, and social choice. Implications for transformative consumer research, social marketing, and public policy. Conceptual and methodological developments in academic research from marketing and related disciplines. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MKTG 6984:

Special Study

NONE

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 Dissert

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BIOMEDICAL ENGINEERING

Pamela VandeVord, Head
Hampton Gabler, Associate Head
Joel Stitzel, Associate Head

Professors: Luke Achenie; Masoud Agah; Graca Almeida-Porada; Anthony Atala; Khalil Bitar; John Bourland; Rafael Davalos; Thomas Diller; Stefan Duma; Wu-Chun Feng; Michael Friedlander; Hampton Gabler; Harold Garner; Francis Gayzik; William Gmeiner; Robert Gourdie; Metin Gurcan; David Herrington; Daniel Kim-Shapiro; Paul Laurienti; Liwu Li; Kerry Link; Timothy Long; Chang Lu; Roop Mahajan; Pendleton Montague; Michael Morykwas; Michael Munley; T Murali; Maury Nussbaum; Emmanuel Opara; Boris Pasche; Padmavathy Rajagopalan; John Rossmeisl; Peter Santago; Thomas Smith; Shay Soker; Harald Sontheimer; Joel Stitzel; Mark Stremler; Charles Tegeler; Pamela VandeVord; William Wagner; James Yoo; Wei Zhang;

Associate Professors: Bahareh Behkam; Raffaella De Vita; Zachary Doerzaph; Yaorong Ge; Aaron Goldstein; Craig Hamilton; Warren Hardy; Brooks King-Casas; Stephen LaConte; Yong Lee; Alexander Leonessa; Anthony Marsh; Lacey McNally; Xin Ming; Amrinder Nain; Steven Poelzing; Christopher Porada; Robin Queen; Justin Saul; Sean Simpson; John Socha; Anne Staples; Umit Topaloglu; Costin Untaroiu; Mark Van Dyke; Vincent Wang; Christopher Whitlow; Abby Whittington; Chris Wyatt; Yong Xu; Jianhua Xuan; Dawen Zhao;

Assistant Professors: Kristen Beavers; Philip Brown; Guohua Cao; John Chappell; Arjun Chatterjee; Tracy Criswell; Kerry Danelson; Howard Gage; Adam Hall; Youngkyoo Jung; Deborah Kelly; Andrew Kemper; Bethany Kerr; Kenneth Kishida; Sang Lee; Nicole Levi; Sarah McDonald; Alexei Morozov; Konark Mukherjee; Jennifer Munson; Sean Murphy; Alexander Powers; Elaheh Rahbar;

Steven Rowson; Aleksander Skardal; Rong Tong; Alexandrina Untaroiu; Jillian Urban; Scott Verbridge; Sujith Vijayan; Eli Vlaisavljevich; Thaddeus Wadas; Ashley Weaver; Jared Weis; Jeff Wiley; Yizheng Zhu;

L. Preston Wade Professor: Rafael Davalos;

Samuel Herrick Professor: Hampton Gabler;

Harry C. Wyatt Professor: Stefan Duma;

H. G. Prillaman Professor: Maury Nussbaum;

Fred W. Bull Professor: Chang Lu;

Lewis A. Hester Chair Professor: Roop Mahajan;

Robert E. Hord Professor: Padmavathy Rajagopalan;

Research Professors: John Robertson;

N. Waldo Harrison Professor: Pamela VandeVord;

Kevin P. Granata Fellow: Vincent Wang;

General Contact: amturne3@vt.edu

Program Web Site: http://www.sbes.vt.edu/

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. and Ph.D. in Biomedical Engineering, and two combination degrees; a DVM/PhD offered through the Veterinary School in Blacksburg, and an MD/Ph.D. offered through the Wake Forest University School of Medicine. The SBES curriculum currently consists of courses and research focused in seven broad areas of concentration which include: · Biomechanics · Tissue Engineering · Biomedical Imaging · Neuroengineering · Nanomedicine & Nanobioengineering · Translational Cancer Research · Cardiovascular Engineering Students are encouraged to adhere to the concentration area requirements specified by each faculty group; however, declaring a specific area is not required. 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 www.sbes.vt.edu 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 (Blacksburg, Wake Forest)

GRE

General Test: Verbal, Quantitative, Analytical Writing (4.0)

GRE COMBINED (V & Q): Minimum "Old" Combined score (1200.0), Minimum "New" Combined score (310.0)

TOEFL

Paper: (600.0)

iBT: (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 graduate schools, which must be noted on the plan of study. 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) each semester of all the academic years 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 participate in the annual Research Symposium held each spring, and are required to do an oral research presentation at least once before they graduate. Ph.D. students may elect to earn an M.S. degree 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 www.sbes.vt.edu for details regarding all degree requirements.

MS Degree

Offered In (Blacksburg, Wake Forest)

GRE

General: Verbal, Quantitative, Analytical (4.0)

TOEFL

Paper: (600.0)

iBT: (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) each semester of all the academic years during their degree program. M.S. students must complete training in Ethics, required by the graduate schools, which must be noted on the plan of study. See the SBES Graduate Handbook for details regarding implementation on 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.

GRADUATE COURSES (BMES)

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

Instruction Type(s): Lecture

Prerequisite(s): BMES 5004 OR BMVS 4064 (UG) OR BMES 4064 (UG)

Corequisite(s):

BMES 5044 (BSE 5044) (CHE 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

Instruction Type(s): 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 muscel 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s): BMES 5044

BMES 5064:

Quantitative Organ Systems Physiology

Mathematical modeling, sumulation, 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s): BMES 5044

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

Instruction Type(s): 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. (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):

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): BMES 5004

Corequisite(s): BMES 5164

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): 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 sovle 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 (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):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMES 5434 (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

Instruction Type(s): 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

Instruction Type(s): 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 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. (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):

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 calculis. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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:

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 ofcontinuum 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMES 5944:

Seminar

NONE

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMES 5974:

Independent Study

NONE

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

NONE

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

NONE

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:

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

Instruction Type(s): Lecture

Prerequisite(s): (BMES 5164 (UG) OR ME 5754 (UG)) OR (BMES 5164 OR ME 5754)

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 commerical 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

Instruction Type(s): Lecture

Prerequisite(s): (BMES 5164 OR ME 5754), (BMES 6164 OR ME 6754)

Corequisite(s):

BMES 6504:

Medical Imaging I

Medical Imaging I provides an introduction to basic imaging science and to two medical imaging disciplines: Radiography and Nuclear Medicine. Topics include: an overview of the underlying physical processes; data acquisition, sampling, and quantization; image reconstruction techniques; relationships between the various modalities; and clinical and industrial applications. Each modality is reviewed in the context of its underlying physical processors, basic imaging parameters (resolution, contrast, and noise), and medical applications. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMES 6514:

Medical Imaging II

Medical Imaging II provides an introduction to three medical imaging modalities: Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and Ultrasound. Potential topics to be covered under emerging technologies are TeraHertz Imaging, Optical Imaging, and Molecular Imaging. Each imaging modality will cover the underlying physical processes; data acquisition, sampling, quantization; image reconstruction techniques; relationship between the various modalities; and clinical and industrial applications. Each modality is reviewed in the context of its underlying physical processes, as well as a common model describing such basic imaging parameters as resolution, contrast, and noise. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): BMES 5554

Corequisite(s):

BMES 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BMES 7994:

Research and Dissertation

NONE

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

David Bevan, Head

Professors: Christopher Barrett; Josep Bassaganya-Riera; David Bevan; Daniela Cimini; Glenda Gillaspy; Elizabeth Grabau; Ruth Grene; Lenwood Heath; Ina Hoeschele; Madhav Marathe; Christopher North; Mohammad Saghai-Maroof; Adrian Sandu; Clifford Shaffer; Edward Smith; Zhijian Tu; John Tyson; Richard Veilleux; Layne Watson;

Associate Professors: Yang Cao; Stephen Eubank; Richard Helm; John Jelesko; Christopher Lawrence; Henning Mortveit; Biswarup Mukhopadhyay; T Murali; Alexey Onufriev; Ryan Senger; Igor Sharakhov; Boris Vinatzer; Liqing Zhang; Jinsong Zhu;

Assistant Professors: Jing Chen; Silke Hauf; Jason Holliday; Maria Lazar; Song Li; William Mather; Florian Schubot; Mark Williams;

Research Assistant Professors: Bryan Lewis;

Graduate Contact: anon55@bi.vt.edu

Graduate Contact: dennie@vt.edu

GBCB Home Page: https://gbcb.vbi.vt.edu/gbcb/

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. This 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: Biocomplexity Institute, Torgersen Hall, Derring Hall, Life Sciences Building I, Latham Hall, McBryde Hall, Fralin Hall, Engel Hall, Seitz Hall, Price 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 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: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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 some 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 the secondary tracks for that student. Requirements will differ among the specialty tracks, with some tracks requiring more coursework, 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 (e.g., CSES/GBCB 5844 - Plant Genomics) Secondary Track(s)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 CSES/GBCB 5844 or equivalent. 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 prelim and a final exam. The preliminary exam, oral and written, is conducted by the student's advisory committee. During the period of time between the end of the third year and end of the fourth year of study, 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 in order to fulfill the research requirement of the Ph.D. 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GBCB 5424 (BIOL 5424) (CS 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GBCB 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 9

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GBCB 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

INFORMATION TECHNOLOGY

Parviz Ghandforoush, Head

Professors: Ing Ray Chen; Stephen Edwards; Parviz Ghandforoush; Scott Midkiff; Narendran Ramakrishnan; Joseph Tront;

Associate Professors: Donald Hatfield; Barbara Hoopes; Lara Khansa; Raymond Major; Linda Tegarden; Yaling Yang;

Assistant Professor of Practice: Kendall Giles; Gregory Kulczycki;

General Contact: vtmit@vt.edu

Graduate Contact: gillcash@vt.edu

Graduate Site: http://www.vtmit.vt.edu

The online graduate program in Information Technology offers an essential upgrading of skills to working professionals desiring to participate in the rapidly expanding area of information technology. It is a unique interdisciplinary degree program offered collaboratively by Virginia Tech's College of Engineering and the Pamplin College of Business. The VTMIT program is fully asynchronous but provides faculty-to-student, and student-to-student interaction that is comparable to a live classroom. The program is an innovative blend of coursework in eight related information technology modules that are updated regularly to reflect industry changes. Students may pursue the Master of Information Technology degree, or choose to enroll as a non-degree student if looking to increase their expertise in a specific concentration. Graduate certificates are also available.

SPECIAL FACILITIES

The master's degree program in Information Technology is only offered in an online format. Students may take courses online from any location around the country and the world. There are no residency requirements.

Virtual

The Master of Information Technology program is offered online as a fully asynchronous degree. Students may take courses online from any location around the country and the world. There are no residency requirements.

DEGREES OFFERED

MIT Degree

Offered In (Virtual)

TOEFL

Paper: (550.0)

Computer: (80.0)

IELTS: (6.5)

Thirty-three credits are required for the Master of Information Technology degree. Each student must complete four of six offered core courses, and seven electives or the equivalent in modules. Modules include Analytics and Business Intelligence, Big Data, Business Information Systems, Decision Support Systems, Health Information Technology, Information Security, Networking, and Software Development. The foundation courses include Fundamentals of Computer Systems, Information Systems Design & Database Concepts, Object-Oriented Analysis & Design (Java), Software Engineering, Strategic Leadership in Technology-Based Organizations, and Web-based Applications and E-Commerce. Graduate Certificates are also offered in Business Analytics and Data Mining; Database Management; Information Security and Analytics; Health Information Technology, Software Development; Management of Technology.

MACROMOLECULAR SCIENCE AND ENGINEERING

Robert Moore, Program Director

Emeriti Faculty: John Dillard; Garth Wilkes;

Professors: Donald Baird; Romesh Batra; Scott Case; Richey Davis; David Dillard; Kevin Edgar; Alan Esker; Charles Frazier; Harry Gibson; Barry Goodell; James Heflin; Matthew Hull; Erdogan Kiran; John Lesko; Timothy Long; Roop Mahajan; Herve Marand; Steven McKnight; Robert Moore; Judy Riffle; Sam Turner; Joseph Wheeler; Michael von Spakovsky;

Associate Professors: Marwan Al-Haik; Justin Barone; Paul Deck; Michael Ellis; Earl Foster; Aaron Goldstein; Louis Madsen; Stephen Martin; Padmavathy Rajagopalan; Maren Roman; Diego Troya; Christopher Williams;

Assistant Professors: Irving Allen; Bahareh Behkam; Lissett Bickford; Shengfeng Cheng; Tijana Grove; Deborah Kelly; Guoliang Liu; John Matson; Frederick Michel; Amanda Morris; Amrinder Nain; Vinh Nguyen; Gary Seidel; Chenggang Tao; Scott Verbridge; Abby Whittington;

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;

Graduate Contact: carpenetti@vt.edu

General Contact: kfelix@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, and Goodwin Hall.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 Communciations and Presentation Methods (1 cr.) (sample syllabus)* 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)* 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 contect 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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MACR 5974:

Independent Study

NONE

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):

MACR 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

MACR 5994:

Research and Thesis

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BIOLOGICAL SCIENCES

Brenda Winkel, Head

Professors: John Barrett; Lisa Belden; Ernest Benfield; Daniela Cimini; Joseph Falkinham; Michael Friedlander; Khidir Hilu; Roderick Jensen; Liwu Li; Ignacio Moore; Erik Nilsen; Brent Opell; John Phillips; David Popham; Jill Sible; Ann Stevens; John Tyson; Jeffrey Walters; Brenda Winkel;

Associate Professors: Bryan Brown; Daniel Capelluto; Carla Finkielstein; Michael Fox; Dana Hawley; Deborah Kelly; Christopher Lawrence; Maria Lazar; Stephen Melville; Birgit Scharf; Florian Schubot; Richard Walker; Zhaomin Yang;

Assistant Professors: Frank Aylward; Cayelan Carey; Erin Hotchkiss; Caroline Jones; Shihoko Kojima; Kate Langwig; Meryl Mims; Martha Munoz; Kendra Sewall; James Smyth; Josef Uyeda; Susan Whitehead;

Affiliated Faculty: Leah Johnson; John Socha;

University Distinguished Professor: John Tyson;

Harold Bailey Professor: Jeffrey Walters;

Research Associate Professors: Hehuang Xie;

Graduate Contact: BiologyGrad@vt.edu

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

Graduate Course Descriptions:

http://www.biol.vt.edu/graduates/course_descriptions/graduate_course_descriptions.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 31. Applications are accepted after this date but the opportunities for financial aid are diminished. Most graduate teaching assistantships are awarded by April 1. 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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DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

M.S.: Must take a minimum of 12 hours at the 5000 level, and a maximum of 3 hours at the 4000 level, and 3 additional hours for seminars for a total of 18 graded hours, plus 12 hours research and thesis. 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

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

Ph.D.: Must take a minimum of 18 graded course hours at the 5000 level and 4 additional hours for seminars for a total of 22 graded hours, plus 68 hours research and dissertation. 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. II

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 (ALS 5064) (PPWS 5064) (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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5074:

Stream Ecology

Application of ecological principles to running water environments. Recitation: critical assessment of contemporary literature and research themes associated with stream ecosystems. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 proceses. 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 5104:

Advanced Developmental Biology

Morphological, physiological and molecular events in embryological and developmental systems, including regulation at the level of transcription, translation, and enzyme or hormone activation. Review of the current literature. Pre-requisite: Graduate standing required.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

Instruction Type(s): 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 5154:

Exercises in Grantsmanship

All aspects of obtaining grant funding in the sciences. Grant writing, ethics, development of proposals for national funding agencies, the peer review system, and participation in a mock grant panel meeting. Pre-requisite: Graduate Standing required.

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

BIOL 5174:

Graduate Seminar

Offered in the major subdisciplines of biology. I,II

Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture
Instruction Type(s): 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 characterists of proteins with biochemical and biophysical techniques. Discussion of research articles related to class topics. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): BCHM 4115
Corequisite(s):

BIOL 5304:

Plant Stress Physiol

Analysis of physiological responses of agricultural and native plants to environmental stresses such as extremes of temperature, availability of water and nutrients, and presence of air pollutants. Emphasis on linking stress caused changes in carbon gain, water loss, nutrient utilization, and energy balance with changes in growth. Laboratory to introduce equipment and research approaches used in greenhouse and field studies. II

Credit Hour(s): 4
Lecture Hour(s): 3
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, Lecture
Prerequisite(s):
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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5424 (GBCB 5424) (CS 5424):

Computational Cell Biology

Use of mathmatical 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 contol, circadian rhythms, cell signaling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5624:

Advanced Microbial Genetics

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

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5664G:

Advanced Virology

Classification, structure, replication, and pathogenesis of viruses of animals, plants and bacteria. Epidemiology, prevention, and treatment. Pre-requisite: Granduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5674:

Adv Pathogenic Bacteriology

Characteristics of bacteria that cause human disease, nature of infectious processes, virulence factors, epidemiology, resistance, immunization. Review of publications in the current literature related to data and statistical analysis and methods.

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 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. Pre-requisite: Graduate Standing required.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5824G:

Advanced Bioinformatic Methods

Application of bioinformatics methods in biological research. Methods to access bioinformatics data. Theory and methods for analysis fo DNA sequences, and analysis of complex data sets including whole denome 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): Lab, Lecture, VB, Online Lecture

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

Prerequisite(s):

Corequisite(s):

BIOL 5834G:

Adv Prac Analysis Prot Str Fnc

Application of biophysical and biochemical methods to characterization of 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 bioinfomatics tools for evaluation and interpretation of mass spectrometry data. Includes three 4-hour lab sessions. Pre-requisite: Graduate Standing required.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BIOL 5854G:

Advanced Cytogenetics

Structure and function of eukaryotic chromosomes, with emphasis on (i) use of model systems to study specific chromosomes substructures or functions; (ii) techniques used to indentify and classify both normal and aberrant chromosomes; and (iii) diseases caused by defective chromosome structure and/or function. Pre-requisite: Graduate Standing

required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): (BIOL 3774 (UG) OR BCHM 4116 (UG)) OR (BIOL 3774 OR BCHM 4116)
Corequisite(s):

BIOL 5974:

Independent Study

NONE
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):

BIOL 5984:

Special Study

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

BIOL 5994:

Research and Thesis

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): 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. I,II
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): 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. II
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): 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. II
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): BIOL 4004
Corequisite(s):

BIOL 6084:

Topics in Cell and Developmental Biology

Readings and discussion of a focused area of cellular and developmental biology, including cell signaling, cell cycle, differentiation and morphogenesis, cytoskeletal regulation and cell death. Topics vary

each semester and course may be repeated with different content up to a maximum of 12 credits. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): BIOL 5884 OR BIOL 4104 (UG) OR BIOL 4104
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. I,II
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): BIOL 4704 (UG) OR BIOL 4704
Corequisite(s):

BIOL 6984:

Special Study

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

BIOL 7994:

Research and Dissertation

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

BIOMEDICAL TECHNOLOGY DEVELOPMENT AND MANAGEMENT

Kenneth Wong, Program Director

Physics: Kenneth Wong;

Research Assistant Professors: Kenneth Wong;

Graduate Contact: khwong@vt.edu

Graduate Site: http://btdm.ncr.vt.edu/

Admission to the BTDM (Biomedical Technology Development and Management) program is currently closed. The Master of Science in Biomedical Technology Development and Management prepares students to meet the challenges of current and future directions in medical product discovery and development and the emerging needs of industry and government. The degree program provides a balance of scientific and management courses that prepare students to critically evaluate biomedical technologies, advance their own careers, and create new startup ventures. Classes are taught primarily in the evenings and on weekends to meet the needs of working professionals. Online and hybrid classes are also part of the program. The technical curriculum covers topics such as immunology, pharmacology, bioinformatics, neuroscience, biomaterials, molecular biotechnology, and medical imaging. Topics in the management curriculum include commercialization, intellectual property, ethics, project management, regulatory agencies, clinical trials, technology licensing, and finance. Students in their second year are encouraged to take on an independent project focused on either scientific research or business development.

SPECIAL FACILITIES

BTDM classes are taught partly at Virginia Tech's Northern Virginia Center, located near the West Falls Church Metro station, and partly at the Virginia Tech Research Center, located near the Ballston Metro station. Some classes are also offered online.

Northern Virginia Center

The Northern Virginia Center, opened in 1997, is Virginia Tech's primary teaching location for graduate programs in the National Capital Region. This 116,139 square foot facility is located adjacent to the West Falls Church Metro station on the Orange line. The facility is the home location for many academic departments in the region, and is also the site for the Graduate Student Services Office (GSSO) located on the fourth floor.Visit our website at www.nvc.vt.edu

DEGREES OFFERED

MS Degree

Offered In (National Capital Region)

GRE

General Test: Verbal, Quantitative, Analytical

TOEFL

Paper: (550.0)

iBT: (80.0)

The Master of Science in Biomedical Technology Development and Management requires 30 semester hours. Many of the classes require independent projects and group presentations, since the ability to analyze information, think critically, and communicate effectively is essential for future career success.

GRADUATE COURSES (BTDM)

BTDM 5214:

Human Immunology

The purpose of the course is to provide an understanding of how the immune system recognizes foreignness outside and inside the body; the tissue damaging consequences of the immune system when it fails to distinguish between non-self and self and the value of immunological reagents in diagnosis and treatment of disease. Pre: graduate standing in the Master of Science in Biomedical Technology Development and Management Program.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BTDM 5224:

Principles of Pharmacology

This course introduces the fundamentals of pharmacology and clinical therapeutics by consideration of pharmacodynamic, pharmacokinetic and biopharmaceutical principles. The course includes physiochemical and biological factors affecting drug action; the absorption, distribution, metabolism and excretion of drugs and the physical and physiological conditions to be considered in drug formulations. Pre: graduate standing in the Master of Science in Biomedical Technology Development and Management Program.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BTDM 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BTDM 5974:

Independent Study

NONE

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):

BTDM 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEMISTRY

Alan Esker, Head

Emeriti Faculty: Harold McNair;

Professors: Paul Carlier; Daniel Crawford; Felicia Etzkorn; Richard Gandour; Harry Gibson; David Kingston; Timothy Long; Herve Marand; Joseph Merola; Robert Moore; Judy Riffle; James Tanko;

Associate Professors: Paul Deck; Louis Madsen; Amanda Morris; Brian Tissue; Diego Troya; Gordon Yee;

Assistant Professors: Tijana Grove; Jatinder Josan; Feng Lin; Guoliang Liu; Nicholas Mayhall; Michael Schulz;

University Distinguished Professor: David Kingston;

Research Professors: Sam Turner;

Graduate Contact: jolih@vt.edu

Graduate Program Director: jrmorris@vt.edu

Graduate Admissions Director: aesker@vt.edu

Graduate Site: http://www.chem.vt.edu/general.php?page=grad

Student Handbook: http://www.chem.vt.edu/media/grad-orange-book.pdf

Admissions: http://www.chem.vt.edu/general.php?page=admiss_grad

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 170 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 six NMR spectrometers, including one at 600 MHz, one at 500 MHz, four at 400 MHz (including a wide-bore instrument for imaging experiments) and a 300 MHz instrument dedicated to solid samples. All modern techniques (multidimensional, multinuclear, variable temperature) are available. Analytical Services also includes LCMS, GCMS, including accurate-mass capability on our Agilent ESI-TOF instrument. 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 ultra-low temperature (to 15 K), high pressure (to 10 GPa), and the ability to analyze small crystals and proteins.

Polymer Characterization Laboratory

The polymer characterization laboratory features GPC, TGA, and DSC, as well as mechanical and rheological testing instruments.

Surface Analysis Laboratory

The Surface Analysis Laboratory features XPS, Auger, and AFM instruments.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal (153.0), Quantitative (157.0), Analytical (4.0)

IELTS

General Test: (8.0)

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: www.chem.vt.edu/media/grad-orange-book.pdf 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

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal (153.0), Quantitative (157.0), Analytical (4.0)

IELTS

General Test: (8.0)

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: www.chem.vt.edu/media/grad-orange-book.pdfEach 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 required 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, and Instrumental Analysis 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5014 (CHE 5014) (MSE 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5094 (FST 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5114:

Advanced Electrochemistry

Discussion of theory and application of chemical equilibrim, reaction rate methods, and electroanalytical methods in analytical chemistry. One year of physical chemistry required. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): CHEM 3616 (UG) OR CHEM 36616

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5154:

Methods in Molecular Biophysics

Modern methods of biophysical measurement, their strengths and limitations, and their application to current research problems. Mass spectrometry, differential scanning calorimetry, isothermal titration calorimetry, surface plasmon resonance, atomic force microscopy, electrophoresis, and fluorescence spectroscopy of biomacromolecules. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (CHEM 2565 (UG) OR CHEM 2565), (CHEM 2566 (UG) OR CHEM 2566) OR CHEM 2514

Corequisite(s):

CHEM 5424G:

Adv Polysaccharide Chemistry

Structure, properties, and application of natural polysaccharides. Natural sources nad methods of isolation. Synthetic chemistry and important polysaccharide derivatives Relation of structure and properties of performance in critical applications including pharmaceuticals, coatings, plastcis, 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CHEM 5505 (UG) OR CHEM 5505

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): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): 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

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CHEM 5505 (UG) OR CHEM 5505

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 chem or consent. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614
Corequisite(s):

CHEM 5704:
Synthesis and Reactions of Macromolecules
Advanced treatment of the kinetics, mechanisms, synthesis and reactions of macromolecules via step and chain processes. PRE: Second year grad standing in chemistry, chemical engineering, or consent. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

CHEM 5805:
Applied Chemistry: Review & Proposal
5805: Review of an active industrial product or process in the field of food, energy and water chemistry; drug discovery chemistry; or polymer chemistry. Assessment of trends in the academic and patent literature relevant to commercial products and processes. Scholarly management of personalized citation databases. A-F only. Pre: Graduate Standing. 5806: Written proposal and oral presentation defense of a possible development study in the field of food, energy and water chemistry; drug discovery chemistry; or polymer chemistry. Literature frameworks and precedent for development studies. Cost-benefit analysis in chemical process and product development. Oral presentatioin and defense of a process development proposal. A-F 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):

CHEM 5806:
Applied Chemistry: Review & Proposal
NONE
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHEM 5805
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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5974:

Independent Study

NONE

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):

CHEM 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEM 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CHEM 6164:

Current Topics in Analytical Chemistry

Special topics in frontier areas of analytical chemistry. Offered when appropriate.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (CHEM 5104 (UG), CHEM 5114 (UG)) OR (CHEM 5104, CHEM 5114)

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614

Corequisite(s):

CHEM 6664:

Current Topics in Physical Chemistry

Special topics in frontier areas of physical chemistry. Offered when appropriate.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614

Corequisite(s):

CHEM 6674:

Physical Chemistry of Polymers

Quantitative treatment of polymer chemical composition, stereochemistry, molecular weight, topology, morphology, viscoelasticity, mechanical behavior. Offered every other year. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): (CHEM 3615 (UG), CHEM 3616 (UG)) OR (CHEM 3615, CHEM 3616)

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): CHEM 5914

Corequisite(s):

CHEM 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHEM 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 20

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ECONOMICS, SCIENCES

Sudipta Sarangi, Head

Emeriti Faculty: Amoz Kats;

Professors: Richard Ashley; Hans Haller; Djavad Salehi-Isfahani; Aris Spanos; Thorwald Tideman;

Associate Professors: Richard Cothren;

Assistant Professors: Alexander Smith;

Wilson Schmidt Professor: Aris Spanos;

General Contact: astanfor@vt.edu

Graduate Program Director: byront@vt.edu

Graduate Contact: wibebout@vt.edu

Graduate Program: https://www.econ.vt.edu

The Virginia Tech Economics program was established September 1, 1961. The program has awarded more than 200 PhDs in economics since its inception. Our graduates now work as successful professionals worldwide in academia, business and government. Since 2000, the program has been administered jointly by the Departments of Economics and of Agricultural and Applied Economics.

SPECIAL FACILITIES

The Department

Students on assistantship are allocated office space in the department in Pamplin Hall. All students have access to computers in their office with internet access. The department has an experimental economics lab in 2088 Derring Hall.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)

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 a free standing terminal master's program. The M.A. degree in Economics is intended to serve advanced VT undergraduate students who participate in the 5th year B.S./M.A. program and those Ph.D. students who begin their studies, but are unable to complete the program.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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECON 5125 (UG) OR ECON 5125

Corequisite(s):

ECON 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECON 2115 (UG) OR ECON 2116 (UG) OR ECON 2115 OR ECON 2116

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECON 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECON 5994:

Research and Thesis

NONE

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (ECON 5005 (UG), ECON 5006 (UG)) OR (ECON 5005, 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECON 5126 (UG) OR ECON 5126

Corequisite(s):

ECON 6044:

Collective Choice

Analysis of decision-making processes in committees, clubs, legislatures, and electrorates.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (ECON 5005 (UG), ECON 5006 (UG)) OR (ECON 5005, ECON 5006)

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

Instruction Type(s): 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. I

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECON 5005 (UG) OR ECON 5005

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

Instruction Type(s): 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). I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECON 5005 (UG) OR ECON 5005

Corequisite(s):

ECON 6554 (AAEC 6554):

Panel Data Econometrics

Introduction to the 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

Instruction Type(s): 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 6604:

Advanced Methods in Applied Microeconomics

Specification and estimation of static, dynamic oligopoly models, application of these models to the study of entry and market structure, vertical relationships, and collusion. Empirical application of auction models to economic development and to public finance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECON 5005

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

Instruction Type(s): Lecture

Prerequisite(s): ECON 5125

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECON 7994:

Research and Dissertation

NONE

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: Gerald Gibbs; James Rimstidt;

Professors: Robert Bodnar; Thomas Burbey; Patricia Dove; Kenneth Eriksson; Michael Hochella; Steven Holbrook; John Hole; Scott King; Richard Law; Nancy Ross; Madeline Schreiber; James Spotila; Robert Tracy; Shuhai Xiao;

Associate Professors: Brian Romans; Robert Weiss; Ying Zhou;

Assistant Professors: Frederick Michel; Sterling Nesbitt; Ryan Pollyea; D Stamps;

Adjunct Professors: Ross Angel; James Beard; Benedetto De Vivo; Nicholas Fraser; William Henika; Michal Kowalewski; James Schiffbauer; Chester Watts;

University Distinguished Professor: Robert Bodnar; Patricia Dove; Gerald Gibbs; Michael Hochella;

Research Professors: Robert Lowell;

Advanced Instructors: Neil Johnson;

Research Scientists: Luca Fedele;

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 http://www.geos.vt.edu/research/facilities.php 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 Derring Electron Beam Laboratory (Cameca SX50 Electron Microprobe and Camscan Series II SEM) Exploration Geophysics Field Equipment Laboratory Fluids Research Laboratory Geothermal Database Hydrothermal Synthesis and Experiment Laboratories Laser-Ablation ICPMS

Laboratory Light Stable Isotope Laboratory Micropaleontology Laboratory Nanogeochemistry, Mineral Surface Geochemistry, and Biogeochemistry Laboratory Optical Microscopy and Digital Photomicrography Laboratory Paleobiology Laboratory Paleoecology Laboratory Physical Hydrogeology Laboratory Radiogenic Helium Laboratory Geochemical Sample Preparation Clean Laboratory Sedimentology and Stratigraphy Laboratory Virginia Tech Seismological Observatory Structural Geology Laboratory Geophysics Computing Facilities Vertebrate Paleontology Laboratory Vibrational Spectroscopy Laboratory X-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 (http://www.ictas.vt.edu/ncfl/index.html) Lithospheric Dynamics and Tectonophysics Laboratory

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Computer: (250.0)

iBT: (80.0)

Paper: (600.0)

GRE

General Test: Verbal (156.0), Quantitative (151.0), Analytical (4.5)

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. 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)

GRE

General Test: Verbal (156.0), Quantitative (151.0), Analytical (4.5)

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. 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

Instruction Type(s): Lecture

Prerequisite(s): GEOS 3204, GEOS 3604

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:

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

Instruction Type(s): 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 asteriods including tectonics, volcanism, impact cratering, regolith formation, mass movement, and weathering. Effect of gravity, heat, pressure, and internal deformation on planets, moons, and asteriods. 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): MATH 2214, MATH 2224

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

Instruction Type(s): Lecture

Prerequisite(s): GEOS 4154 (UG), MATH 4564 (UG), STAT 3005 (UG)

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

Instruction Type(s): Lecture

Prerequisite(s): GEOS 3204

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

Instruction Type(s): Lab, Lecture

Prerequisite(s): GEOS 3204

Corequisite(s):

GEOS 5224:

Clastic Petrography and Diagenesis

Formation of terrigenous particles by weathering, clay mineralogy, clay diagenesis, tectonic control on framework grain composition, quartz arenites and silicretes, feldspathic sandstones, lithic sandstones, greywackes, and controls on sandstone diagenesis. Alternate years.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): GEOS 3504, GEOS 3204, GEOL 4504

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 5254G:

Advanced Earthquake Seismology

Seismicity and its causes in the context of plate tectonics; determination of earthquake location and mechanisms; seismogram (time series) analysis; theory of seismometers; hazard potential; wave propagation; use of earthquakes in determining earth structure. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5404G:

Graduate Advanced Structure

Basic principles of rock behavior under applied, non-hydrostatic stress (experimental and techonic) 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

Instruction Type(s): 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

Instruction Type(s): Lab, Lecture

Prerequisite(s): GEOS 3504, GEOS 3704

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
Instruction Type(s): Lecture
Prerequisite(s): GEOS 3504 OR CHEM 3615
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
Instruction Type(s): Lecture
Prerequisite(s): GEOS 5535 OR CHEM 5525
Corequisite(s):

GEOS 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
Instruction Type(s): 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
Instruction Type(s): Lab, 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 Schreinemaker's 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
Instruction Type(s): Lecture
Prerequisite(s): GEOS 3504, MATH 2224, CHEM 1036
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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

GEOS 5744:

Fluid Inclusions Techniques

The study of fluid inclusions in rocks and minerals from sedimentary, metamorphic, igneous, and ore-forming environments. Basic fluid inclusion principles and techniques and characteristics of inclusions from these various geologic environments will be described. Consent required.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, Lecture
Prerequisite(s):
Corequisite(s):

GEOS 5754:

Fluids in the Earth's 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 earth's crust are considered. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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, Biot's equations and three-dimensional consolidation theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): GEOL 4114, (MATH 2214 OR MATH 2514)

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): 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):

GEOS 5814 (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 BC's and IC's. 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

Instruction Type(s): Lecture

Prerequisite(s): GEOL 4114 OR CEE 4314

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

Instruction Type(s): Lecture

Prerequisite(s): GEOS 4804, (CEE 4314 OR CEE 4594 OR CSES 4594)

Corequisite(s):

GEOS 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GEOS 5994:

Research and Thesis

NONE

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GEOS 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GEOS 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MATHEMATICS

Eric De Sturler, Chair

Professors: Slimane Adjerid; Christopher Beattie; Jeffrey Borggaard; John Burns; Eric De Sturler; Mark Embree; Serkan Gugercin; Peter Haskell; Terry Herdman; Traian Iliescu; Jong Kim; Martin Klaus; Tao Lin; Peter Linnell; Nicholas Loehr; Anderson Norton; Christian Reidys; Michael Renardy; Robert Rogers; John Rossi; Mark Shimozono; Shu Ming Sun; James Turner; Timothy Warburton;

Associate Professors: Mihaela Ciupe; Alexander Elgart; Constantin Mihalcea; Henning Mortveit; Peter Wapperom; Megan Wawro; Pengtao Yue; Lizette Zietsman;

Assistant Professors: Lauren Childs; Julianne Chung; Martin Fraas; Estrella Johnson; Honghu Liu; Daniel Orr; Eyvindur Palsson;

Affiliated Faculty: Lara Anderson; James Gray; Catherine Ulrich; Jesse Wilkins;

Hatcher Professor of Mathematics: John Burns;

Class of 1950 Professor: Michael Renardy;

AV Morris Professor: Serkan Gugercin;

Costain Chair: Timothy Warburton;

General Contact: info@math.vt.edu

Graduate Site: http://www.math.vt.edu/grProspective.php

Student Handbook: http://www.math.vt.edu/grPolicies.pdf

The Department of Mathematics offers programs leading to M.S. and PhD degrees. Both traditional and interdisciplinary options are available for the M.S. degree. Details about the M.S. and PhD degree options can be found in our graduate program policies document available at http://www.math.vt.edu/grPolicies.pdfThe department has internationally recognized excellence in the areas of algebra and combinatorics, algebraic geometry and topology, computational science, continuous and discrete dynamical systems, control theory and optimization, fluid dynamics, math education, mathematical biology and mathematical physics, number theory, numerical analysis, and partial differential equations. This research is supported by collaborations with researchers across Virginia Tech either in other departments or in various centers and institutes. These include, among others, the Center for Mathematical Computation (CMC), the Interdisciplinary Center for Applied Mathematics (a University research center), and the Biocomplexity Institute of Virginia Tech. Please visit the Department of Mathematics at http://www.math.vt.edu/ for more information.

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 and students may use a departmental cluster.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

The M.S. degree is designed to be completed in two years of graduate study. Thesis and non-thesis options are available for the M.S. degree. In the thesis option the student writes and defends a Master's Thesis under the direction of a faculty member. The time spent preparing the thesis is represented by 6 to 9 hours of MATH 5994 (Research and Thesis) among the required courses. The hour and course requirements for each of these degrees are detailed in "Policies and Degree Requirements" at http://www.math.vt.edu/grPolicies.pdf. The department also offers a special interdisciplinary plan for either the thesis or non-thesis M.S. degrees. This plan is intended for students having clearly defined, interdisciplinary career goals. Additional flexibility in the formal requirements allows the student's advisory committee to customize a Plan of Study to the student's goals. It must be emphasized that the interdisciplinary plan is intended only for students who enter the graduate program with specific, interdisciplinary career objectives. The student desiring studies under this plan needs to take the initiative to develop an appropriate Plan of Study at the very outset of his/her graduate studies.Hour requirements: for any of the degree options, the student's Plan of Study must show 30 hours. The courses which make up these 30 hours must meet the constraints indicated in "Policies and Degree Requirements" at http://www.math.vt.edu/grPolicies.pdf. (Transfer credit may be used for up to 50% of coursework numbered 5000 and higher, subject to the advisory committee's approval and Graduate School guidelines.)

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

The PhD requires the completion of 90 hours, of which between 30 and 60 must be MATH 7994 (Research and Dissertation). At least 27 hours must be mathematics courses (excluding Research and Dissertation) numbered 5000 or higher. 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. All transfer credit is subject to the advisory committee's approval and Graduate School guidelines. Courses used toward the M.S. in mathematics may be used toward the PhD as well. More information about the specific requirements for the PhD can be found in "Policies and Degree Requirements" at http://www.math.vt.edu/grPolicies.pdf.

GRADUATE COURSES (MATH)

MATH 5114:

Specialized Topics in Algebra

Various graduate level topics in algebra such as field theory, non-commutative ring theory, group representation theory, Lie algebras. May be taken for credit more than once with departmental permission.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4124

Corequisite(s):

MATH 5125:

Abstract Algebra

Groups, rings and ideals, modules, brief introduction to homological algebra.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4124

Corequisite(s):

MATH 5126:

Abstract Algebra

Groups, rings and ideals, modules, brief introduction to homological algebra.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4124, MATH 5125

Corequisite(s):

MATH 5144 (GEOS 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

Instruction Type(s): Lecture

Prerequisite(s): MATH 2214, MATH 2224

Corequisite(s):

MATH 5225:

Real Analysis

Basic set theoretic and topological notions, fundamental theorems of measure and integration, differentiation, applications to linear analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4226

Corequisite(s):

MATH 5226:

Real Analysis

Basic set theoretic and topological notions, fundamental theorems of measure and integration, differentiation, applications to linear analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4226, MATH 5225

Corequisite(s):

MATH 5235:

Complex Analysis

Holomorphic functions, complex integration and residues, series expansions, normal families and the Riemann mapping theorem, entire functions, power series in the unit disk.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 3224 OR MATH 4225

Corequisite(s):

MATH 5236:

Complex Analysis

Holomorphic functions, complex integration and residues, series expansions, normal families and the Riemann mapping theorem, entire functions, power series in the unit disk.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 3224 OR MATH 4225, MATH 5235

Corequisite(s):

MATH 5245:

Ordinary Differential Equations

Existence theorems, linear theory, stability theory, periodic solutions, Poincare-Bendixon theory, boundary-value problems, functional differential equations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4225

Corequisite(s):

MATH 5246:

Ordinary Differential Equations

Existence theorems, linear theory, stability theory, periodic solutions, Poincare-Bendixon theory, boundary-value problems, functional differential equations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4225, MATH 5245

Corequisite(s):

MATH 5344:

Specialized Topics in Topology and Geometry

Various graduate level topics in topology and geometry. May be taken for credit more than once with department consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4324

Corequisite(s):

MATH 5425:

Applied Partial Differential Equations

Partial differential equations of first and second order, hyperbolic equations, elliptic equations and Green's functions, parabolic equations, canonic forms, application to physics and engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4426 OR MATH 4564

Corequisite(s):

MATH 5426:

Applied Partial Differential Equations

Partial differential equations of first and second order, hyperbolic equations, elliptic equations and Green's functions, parabolic equations, canonic forms, application to physics and engineering.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4426 OR MATH 4564, MATH 5425

Corequisite(s):

MATH 5435:

Principles and Techniques of Applied Mathematics

Methods and techniques for obtaining approximate solutions to differential and integral equations that are not solvable exactly. Asymptotic and perturbation analysis, complex integration. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MATH 5444:

Numerical Methods for Ordinary Differential Equations

Computational procedures for ordinary differential equations including Runge-Kutta methods, variable-step Runge-Kutta methods, predictor-corrector methods, applications to two-point boundary-value problems and parameter estimation. Error control, relative and absolute stability, methods for stiff equations; with computer assignments. Senior standing in engineering, science, or mathematics, and some programming ability required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MATH 5454:

Graph Theory

Graphs, trees, connectivity, Euler tours, matching, independent sets and cliques, planar graphs, directed graphs. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MATH 5464:

Combinatorics

Counting problems, generating functions, recurrence relations, principle of inclusion and exclusion, experimental designs. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MATH 5465 (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. High-level programming language required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4525

Corequisite(s):

MATH 5466 (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. High-level programming language required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4525, MATH 5465

Corequisite(s):

MATH 5474 (CS 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. High-level programming language required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

MATH 5484 (CS 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. High-level programming language required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): MATH 3414, MATH 4525
Corequisite(s):

MATH 5485 (CS 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
Instruction Type(s): Lecture
Prerequisite(s): MATH 4445, MATH 4446
Corequisite(s):

MATH 5486 (CS 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
Instruction Type(s): Lecture
Prerequisite(s): MATH 4445, MATH 4446
Corequisite(s):

MATH 5515 (GBCB 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

MATH 5516:
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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

MATH 5524:
Matrix Theory
Determinants, rank, linear systems, eigenvalues, diagonalization, Gram-Schmidt process, Hermitian and unitary matrices, Jordan canonical form, variational principles, perturbation theory, Courant minimax theorem, Weyl's inequality, numerical methods for solving linear systems and for determining eigenvalues. science or engineering.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

MATH 5545:
Calculus of Variations and Optimal Control Theory
Unified course in the calculus of variations and control theory including multiple integral problems and distributed parameter control systems. Necessary conditions, sufficient conditions, nonclassical problems,

optimal control, distributed parameter control, computational methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4525, MATH 4425

Corequisite(s):

MATH 5546:

Calculus of Variations and Optimal Control Theory

Unified course in the calculus of variations and control theory including multiple integral problems and distributed parameter control systems. Necessary conditions, sufficient conditions, nonclassical problems, optimal control, distributed parameter control, computational methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4525, MATH 4425, MATH 5545

Corequisite(s):

MATH 5614:

Topics for In-Service Teachers

Various topics in mathematics and its applications to real-life problems, presented in light of contemporary instructional technologies and standards of learning. The course is designed for in-service mathematics teachers at the high and middle school levels and is suitable for recertification credit. The specific topics covered will be tailored to the location and delivery mode of the course, as well as evolving standards and methodology. May be repeated for credit with different content. May not be applied toward graduate degrees in mathematics. In-service status 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):

MATH 5624:

Research on Mathematical Knowing and Learning

Methods for conducting scientific research on how K-12 students learn mathematics. Students will develop skills for designing and conducting such research across various domains of mathemathical learning, such as whole numbers, fractions, algebra, and calculus. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MATH 5634:

Research in Undergraduate Mathematics Education

Research on undergraduate mathematics education. Student understanding of particular concepts from undergraduate math courses, from calculus to abstract algebra. Student engagement in mathematical pratices, such as proving and defining, that transcend particular course concepts. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MATH 5974:

Independent Study

NONE

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):

MATH 5984:

Special Study

NONE

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):

MATH 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MATH 6255:

Functional Analysis

Banach spaces, Hilbert spaces, linear operators on Banach and Hilbert spaces, Riesz Representation Theorems, spectral theory, topological vector spaces, other topics in functional analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 5226

Corequisite(s):

MATH 6256:

Functional Analysis

Banach spaces, Hilbert spaces, linear operators on Banach and Hilbert spaces, Riesz Representation Theorems, spectral theory, topological vector spaces, other topics in functional analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 5226, MATH 6255

Corequisite(s):

MATH 6324:

Topics in Topology and Geometry

Advanced topics in topology and geometry. May be taken for credit more than once with department consent, with different content.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 5344

Corequisite(s):

MATH 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PSYCHOLOGY

Roseanne Foti, Chair

Professors: Martha Ann Bell; Warren Bickel; George Clum; Jack Finney; E Geller; Russell Jones; Thomas Ollendick; Robert Stephens; Richard Winett;

Associate Professors: Danny Axsom; Lee Cooper; Julie Dunsmore; David Harrison; Neil Hauenstein; Bruce Scarpa-Friedman;

Assistant Professors: Charles Calderwood; Anthony Cate;

Research Faculty: Sharon Ramey; Craig Ramey;

Alumni Distinguished Professor: E Geller;

University Distinguished Professor: Thomas Ollendick;

Heilig Meyers Professor: Richard Winett;

Senior Instructors: Kurt Hoffman;

Research Assistant Professors: Vanessa Diaz;

Graduate Contact: vlander@vt.edu

General Contact: mwooddel@vt.edu

Graduate Site: http://www.psyc.vt.edu/graduate

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.

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 and Child Study Center 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 Virginia Tech Carilion Research Institute (http://info.vtc.vt.edu/phd/), 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 (http://www.psyc.vt.edu/graduate).

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 (http://www.psyc.vt.edu/graduate).

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5294:

Psychophysiology

Intensive study of the distinct psychophysiologcial methodology and approach to the problem of physiological-behavioral correlation. Several primary areas of psychophysiology are presented: autonomicsomatic 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PSYC 5544:

Cognitive Development

Cognitive development throughout the life-span. Emphasis on Piaget's 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
Instruction Type(s): 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 intereactions.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): PSYC 5534
Corequisite(s):

PSYC 5965:

Clinical Practicum

Supervised training appropriate to the student's 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

PSYC 5966:

Clinical Practicum

Supervised training appropriate to the student's 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

PSYC 5974:

Independent Study

NONE
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

NONE
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

NONE
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
Instruction Type(s): Lecture

Prerequisite(s): PSYC 5315, (STAT 5605, STAT 5606) OR (STAT 5615, STAT 5616) OR (STAT 5665, STAT 5666)
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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

PSYC 6965:

Clinical Practicum

Supervised training appropriate to the student's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PSYC 6966:

Clinical Practicum

Supervised training appropriate to the student's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PSYC 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

STATISTICS

Ronald Fricker, Head

Professors: Robert Gramacy; David Higdon; Ina Hoeschele; Sallie Keller; Eric Smith; Gordon Vining; William Woodall;

Associate Professors: Xinwei Deng; Pang Du; Marco Ferreira; Feng Guo; Yili Hong; Leanna House; Inyoung Kim; Scott Leman; George Terrell;

Assistant Professors: Christopher Franck; Leah Johnson; Shyam Ranganathan; Srijan Sengupta; Xiaowei Wu;

Collegiate Assistant Professors: Anne Driscoll;

Research Assistant Professors: Allison Tegge;

Associate Professor of Practice: Jennifer Van Mullekom;

Graduate Contact: chconne1@vt.edu

Director of Graduate Programs: marf@vt.edu

Graduate Site: https://www.stat.vt.edu/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, students in cooperation with faculty members become involved in on-campus collaboration activities. M.S. students are required to participate in statistical collaboration within the Statistical Applications and Innovations Group (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: (80.0)

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. Each student must pass a qualifying examination after completing the core courses and a final oral examination after completing the plan of study. The Ph.D. plan of study requires a minimum of 90 semester hours of work beyond the baccalaureate, including at least 58 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), required courses for the Ph.D. are Advanced Topics in Statistical Inference and three other Ph.D. level courses from approved lists of courses, which vary by track. Each candidate for the Ph.D. must pass the qualifying examination at the Ph.D. level.Flexibility is provided to the graduate program through five Ph.D. concentrations or tracks, which include the Traditional Track, the Bioinformatics Track, the Computational Track, the Environmental Track, and the Industrial Track. The Traditional Track encompasses the general pursuit of research in statistical theory and methods, allowing considerable freedom in choice of coursework within and outside the department. The Bioinformatics, Computational, Environmental, and Industrial Tracks offer more specialized statistical training geared toward application areas in which the department has particular expertise. In accord with their specialized nature, these four tracks are more stringent in requirements for relevant coursework than the Traditional Track. An option in Bioinformatics is also available.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (150.0), Quantitative (160.0), Analytical (3.0)

The M.S. plan of study requires 35 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. Each student must pass a qualifying examination after completing the core courses and a final oral examination after completing the plan of study. The Ph.D. plan of study requires a minimum of 90 semester hours of work beyond the baccalaureate, including at least 59 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), required courses for the Ph.D. are Advanced Topics in Statistical Inference and three other Ph.D. level courses from approved lists of courses, which vary by track. Each candidate for the Ph.D. must pass the qualifying examination at the Ph.D. level.Flexibility is provided to the graduate program through five Ph.D. concentrations or tracks, which include the Traditional Track, the Bioinformatics Track, the Computational Track, the Environmental Track, and the Industrial Track. The Traditional Track encompasses the general pursuit of research in statistical theory and methods, allowing considerable freedom in choice of coursework within and outside the department. The Bioinformatics, Computational, Environmental, and Industrial Tracks offer more specialized statistical training geared toward application areas in which the department has particular expertise. In accord with their specialized nature, these four tracks are more stringent in requirements for relevant coursework than the Traditional Track. An option in Bioinformatics is also available.

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. I

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s): STAT 5004

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 reseach questions, and managing an effective statistical collaboration meeting.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): STAT 5014 (UG)
Corequisite(s): STAT 5124, STAT 5204

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): null null
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
Instruction Type(s): Lecture
Prerequisite(s): STAT 5615, STAT 4584 OR MATH 4584
Corequisite(s): STAT 5014

STAT 5104:

Probability and Distribution Theory

Fundamental concepts of probability, random variables and their distributions, functions of random variables, mathematical expectations, and stochastic convergence. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5114, MATH 5524

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5104 OR STAT 5616

Corequisite(s):

STAT 5204G:

Experimental Design: Concepts and Applications

Fundamental princples 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, imcomplete block designs, repeated measures, power and sample size, mean separation procedures.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): STAT 5605 OR STAT 5615

Corequisite(s):

STAT 5304:

Statistical Computing

Computational methods for statistical computing problems. Orthogonal transformations, sweep operators, and other numerical methods applied to general optimization techniques for maximum likelihood and least squares estimation problems. Knowledge of SAS programming language required. Even years. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5124

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:

Hierarchial Modeling

Hierarchial modeling techniques as applied to assess data with atypical features, such as non-normal responses (e.g., binary, discrete survival, continous 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

Instruction Type(s): Lecture

Prerequisite(s): STAT 5044, STAT 5104, STAT 5444

Corequisite(s):

STAT 5364G:

Advanced Statistical Genomics

Statistical methods for bioinformatics adn 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 adn 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 safey 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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, martales, Brownian motion and related stationary Gaussian processes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5104, STAT 5114

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, cluste analysis. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5124 OR STAT 5616

Corequisite(s):

STAT 5514G:

Advanced Contingency Table Analysis

Statistical techniques for frequency data. Goodness-of-fit. Tests and measures of association for two-way tables. Log-linear models for multidimensional tables. Parameter estimation, model selection, incomplete tables, ordinal categories, logistic regression. Use of SAS or SPSS statistical software.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 4706 OR STAT 5616

Corequisite(s):

STAT 5525 (CS 5525):

Data Analytics

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 classsification, 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-organizating map methods. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

STAT 5526 (CS 5526):

Data Analytics

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 throughly 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

Instruction Type(s): Lecture

Prerequisite(s): STAT 5525 OR CS 5525

Corequisite(s):

STAT 5534:

Analysis of Multivariate Categorical Data

Log-linear models for unconstrained and ordinal multidimensional contingency tables; testing and estimation; random and structural zeros; model building; logit models and logistic regression; and use of major statistical packages. Knowledge of CMS required. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5124

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

Instruction Type(s): Lecture

Prerequisite(s): STAT 5124

Corequisite(s):

STAT 5554:

Functional Data Analysis

Funcational 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 5564:

Statistical Genetics

Statistical methods for linkage mapping of quantitative trait genes in populations ranging from inbred lines to complex pedigrees. Statistical methods to fine-map genes using linkage disequilibrium. Population genetic analyses of DNA sequence data. Statistical methods include multiple regression, (co)variance components estimation, Maximum Likelihood and Bayesian analyses. Algorithms to implement these methods include Expectation-Maximization, Markov chain Monte Carlo, neural networks, and genetic algorithms. Data are discrete or continuous. Odd years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (STAT 5004) OR (STAT 5615, STAT 5616), (ALS 5105)

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. III

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. 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):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,III

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. II,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): STAT 5616 OR STAT 5606

Corequisite(s):

STAT 5674:

Methods in Biostatistics

Statistical principles and methods required for effective clinical trial and clinical experiment design and analysis. Topics include graphical and numerical exploratory data analysis, and comparative tests of categorical, ordinal, and continuous data, simple, multiple linear and logistic regression analysis, design of experiments and sampling theory. Additional topics include diagnostic tests, relative risk, odd ratio, and estimation of effective dose. Students will learn to properly interpret

output from statistical 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):

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
Instruction Type(s): Lecture
Prerequisite(s): STAT 5044, STAT 5104, STAT 5114
Corequisite(s):

STAT 5694:

Longitudinal Data Analysis

Application and theory for longitudinal data analysis for both continuous and categorical response data, including the use of statistical software for data analysis. Topics include ANOVA, MANOVA, random-effects model, convariance pattern models, generalized estimation equations models, random-effects logistic regression models, and missing data in longitudinal studies. Pre-requisite: Working knowledge of statistical software.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): STAT 5004, STAT 5104, STAT 5114
Corequisite(s):

STAT 5754:

Internship in Statistics

Full time, supervised intership 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
Instruction Type(s): Lecture
Prerequisite(s): STAT 5024
Corequisite(s):

STAT 5894:

Final Examination

NONE
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

STAT 5904:

Project and Report

. I,II,III,IV,V
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): 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). I,II
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

STAT 5974:

Independent Study

NONE
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):

STAT 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5114

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

Instruction Type(s): 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

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5124, STAT 5514

Corequisite(s):

STAT 6564 (AAEC 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):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5634

Corequisite(s):

STAT 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

FISHERIES AND WILDLIFE SCIENCES

Joel Snodgrass, Head

Emeriti Faculty: Richard Neves; Michael Vaughan;

Professors: Paul Angermeier; James Fraser; Carola Haas; Eric Hallerman; William Hopkins; Brian Murphy; Donald Orth; Dean Stauffer;

Associate Professors: Kathleen Alexander; C Dolloff; William Ford; Emmanuel Frimpong; Yan Jiao; Sarah Karpanty; Marcella Kelly; Steve McMullin; James Parkhurst;

Assistant Professors: Leandro Castello;

Graduate Contact: karpanty@vt.edu

Graduate Site: http://www.fishwild.vt.edu/pros_graduate.htm

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, 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. 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 for laboratory analysis, small-scale aquatic experiments, small-animal holding, computer analysis, and geographic information systems. Latest computer technology is available. The department collaborates frequently with the Conservation Management Institute, a research, survey, and outreach organization that grew out of the department's research program. Off campus aquaculture laboratories provide state-of-the-art facilities for endangered species aquaculture. Center Woods is an off-campus woodlot housing captive animal facilities for black bear and other animals. Most student research, however, is conducted in field locations; most projects are in Virginia and adjacent states, but current projects also occur in Alaska, South Dakota, Florida, and other states, as well as Belize, Indonesia, Botswana, and other countries.

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 upon 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, Wildlife Ecotoxicology and Physiological Ecology Laboratory, and the Ecological Research Archive.

Off-Campus Facilities

Two research groups, the conservation genetics and ecotoxicology groups, have research laboratories in the Corporate Research Center approximately two miles from the main Blacksburg campus. Off campus aquaculture laboratories provide state-of-the-art facilities for aquaculture of imperiled species, focusing on freshwater mollusk. Center Woods is an off-campus woodlot housing captive animal facilities for black bear and potentially for other animals. Most student research is conducted in field locations; most projects are in Virginia and adjacent states, but current projects also occur in Alaska, South Dakota, Florida, and other states, as well as Belize, Indonesia, Botswana, and other countries.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (550.0), Quantitative (600.0), Analytical (600.0)

We offer M.S. and Ph.D. degrees in Fisheries and Wildlife Science. 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) and GRE scores at or above 156 (550 on old scale) in verbal and 148 (600 in old scale) in quantitative and analytical areas. 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'd 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 re-checking this web site periodically. 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. Most graduates are expected to satisfy certification requirements for either the American Fisheries Society or The Wildlife Society; this may require additional course work by students entering the program from other disciplines. 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.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (550.0), Quantitative (600.0), Analytical (600.0)

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) and competitive GRE scores in quantitative and analytical areas. 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'd 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 a sponsored contract 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 re-checking this web site periodically. 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. Most graduates are expected to satisfy certification requirements for either the American Fisheries Society or The Wildlife Society; this may require additional course work by students entering the program from other disciplines. All students must deliver at least two seminars and write a semi-technical manuscript about their research. Doctoral students are required to take a diagnostic exam 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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): Lab, 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

Instruction Type(s): 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

Instruction Type(s): Lab, Lecture

Prerequisite(s):

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): BIOL 4004

Corequisite(s):

FIW 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FIW 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FIW 5974:

Independent Study

NONE

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):

FIW 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): FIW 5114

Corequisite(s):

FIW 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FIW 7994:

Research and Dissertation

NONE

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; Harold Burkhart; Robert Hull; Stephen Schoenholtz; John Seiler; Bradley Sullivan; Randolph Wynne;

Associate Professors: Michael Bolding; Amy Brunner; Carolyn Copenheaver; Susan Day; Jason Holliday; Kevin McGuire; John Munsell; Philip Radtke; Marc Stern; Brian Strahm; Valerie Thomas; Phillip Wiseman;

Assistant Professors: Scott Barrett; Thomas Coates; Kelly Cobourn; Daniel McLaughlin; Stella Schons Do Valle; Michael Sorice; Robert Thomas;

Affiliated Faculty: Jeffrey Marion;

Julian N. Cheatham Professor of Forestry: Gregory Amacher;

University Distinguished Professor: Harold Burkhart;

Shelton H. Short, Jr., Professor of Forestry: John Seiler;

General Contact: frec@vt.edu

Website: http://www.frec.vt.edu

Virginia Tech's Department of Forest Resources and Environmental Conservation is one of the leading programs in natural resource management in the United States. Our teaching and research focus on the latest applications to uncover the science needed to manage forests and other natural resources. Our programs are diverse and approach critical natural resource issues from many disciplinary perspectives. From protected areas management and economic policy to forest soil productivity, urbanization, and genomics, we seek to discover new knowledge and technology to address the global challenges to come.

SPECIAL FACILITIES

Virginia Tech's Department of Forest Resources and Environmental Conservation has over 2,000 acres of forested land for research use, as well as state-of-the-art laboratories and greenhouses. Facilities are primarily located on or near campus; at the Reynolds Homestead in Critz, Virginia; and at the Institute for Advanced Learning and Research in Danville, Virginia. Julian N. Cheatham Hall Serving as the primary campus building for forestry and natural resources studies, Cheatham Hall houses exceptional teaching and research laboratories, computer labs, faculty and graduate student offices, and administration. Forestry laboratories include: Dendrochronology & Ecology Laboratory Human Dimensions Analysis Laboratory Urban Forestry Laboratory Dendrology Teaching Laboratory Forest Soils Teaching Laboratory Latham Hall Dedicated in 2006, Latham Hall provides greatly-expanded and fully-outfitted laboratory space, one-of-a-kind growth chambers that allow study of large trees, soil and plant material preparation areas, conference rooms, and faculty offices. Laboratory and research space includes: Forest Ecophysiology Laboratory Forest Molecular Genetics and Biotechnology Laboratory Forest Tree Nutrition Laboratory Forest Soils & Hydrology Laboratory Water Resources Center Laboratory Plant Preparation Facility Soil Preparation Facility Six full-size growth chambers Fishburn Forest A 1,353-acre demonstration forest of the Appalachian hardwood and mixed pine-hardwood type, the College of Natural Resources and Environment's Fishburn Forest provides ample space for laboratories and research in the Ridge and Valley physiographic region. It is located 10 minutes from the Blacksburg campus. Reynolds Homestead Forest Resources Research Center The Reynolds Homestead Forest Resources Research Center is a 710-acre research unit located in the Virginia Piedmont approximately 70 miles from Blacksburg. It is equipped with a laboratory, greenhouse, slat house, nursery bed, ample field space, and is well staffed for program support. Center for Environmental Applications of Remote Sensing (CEARS) The CEARS lab is a state-of-the-art research facility developed by several Virginia Tech researchers from multiple departments who have formed partnerships with other industries, institutions, and governments to solve a wide array of environmental problems. CEARS was established in 1997 as a NASA Center of Excellence in applications of remote sensing to regional and global integrated environmental assessments. It is Virginia Tech's focal point for interdisciplinary research, instruction, and outreach focused on remote sensing applications. CEARS researchers have extensive expertise with a wide variety of data types (e.g., active and passive microwave, multispectral, hyperspectral, lidar, aerial photographs) and application areas (e.g., temperate and tropical forestry, limnology, ecological modeling, marine biology, environmental monitoring, urban ecology, carbon sequestration, tropical biodiversity assessment, rangeland management, invasive species, fire fuel loading). The CEARS laboratory is physically and administratively housed within the College of Natural Resources and

Environment but is shared with other colleagues and constituencies, both on campus and off. Virginia Water Resources Research Center (VWRRC) VWRRC was established at Virginia Tech in 1965 by the U.S. Congress as one of the nation's 54 water institutes and is affiliated with the College of Natural Resources and Environment. The center's mission is to offer research and educational opportunities to water scientists and students and provide citizens and government leaders with water science information. Institute for Advanced Learning and Research The Departments of Horticulture and Forest Resources and Environmental Conservation operate a state-of-the-art tissue culture research laboratory at the Institute of Advanced Learning and Research in Danville, Virginia. Greenhouses The university has ample greenhouse facilities located on the Virginia Tech campus. FREC maintains a soil and plant preparation facility as part of the greenhouse complex. In addition, FREC faculty have access to a fully-automated greenhouse facility in nearby Newport, Virginia, as well as greenhouses at the Reynolds Homestead. Harvesting Research Laboratory The department's harvesting laboratory is located in Blacksburg adjacent to the Virginia Tech campus. This 2,400-square-foot facility has a fully-equipped machine shop for fabricating new machine designs and supporting the skidders, loader, trucks, and other equipment used in field research. Urban Horticulture Center The Urban Horticulture Center (UHC) of Virginia Tech, located about three miles from campus, was established in 1989. The UHC is a facility of the Horticulture Department but also provides facilities for closely-related research projects, primarily in urban forestry. The center includes field plots, unheated poly houses, a pot-in-pot growing area, equipment storage, walk-in cooler, and office space.

DEGREES OFFERED

MS Degree

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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-research degree intended to serve the needs of (1) those who have a prior forestry degree and who wish to enhance their knowledge and skills or (2) those who have no previous degree in forestry. 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 30 credit hours in formal course work, inclusive of hours credited towards the degree paper, must be passed with a minimum QCA of 3.0 for courses in the program of study. Students entering the M.F. program without prior forestry education must demonstrate competency in appropriate topics such as forest biology, dendrology, or forest ecology in addition to completing the usual M.F. requirements. At the discretion of their graduate committees, these students must either take undergraduate forestry courses to meet these competency requirements or demonstrate knowledge through alternate means such as experience or prior coursework. The M.F. student must pass a comprehensive oral examination covering his/her course work and the degree paper. All Graduate School requirements apply as 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 credits 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 submittal of the working plan are listed in the College of Natural Resources and 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 forestry-related subjects.

PhD Degree

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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. 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 submittal of the working plan are listed in the College of Natural Resources and Environment (CNRE) Graduate Program Procedures. All Ph.D. students in the Department of Forest Resources and Environmental Conservation must demonstrate minimum competency in statistics (see CNRE Graduate Program Procedures for requirements). Doctoral students may be required to take a qualifying exam. The exact nature of the exam is determined by faculty within the student's chosen discipline. The purposes of this examination or assessment are to (1) evaluate the student's comprehensive knowledge in his/her field or study, (2) identify any deficiencies in the student's background and recommend supplementary course work or self-study improvements, and (3) evaluate the student's ability to successfully complete the doctoral degree. A required preliminary exam, oral and/or written, is conducted by the student's advisory committee. This exam 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 forest management and use. The student may be tested on any aspect of forest 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 (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

Instruction Type(s): 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 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FREC 5114:

Geospatial Programming and Analytical Methods

Common 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 intergration of large and varied datasets with empasis on incorporating new 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):

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

Instruction Type(s): Lab, 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 fhe intense conflicts routinely associated with natural resource management and environmental requlation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FREC 5144:

Hillslope and Watershed Hydrol

Physical concepts of hydrological processes that affect age, origin, and flowpaths of water from hillslope to watershed scales. 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 relavant 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

Instruction Type(s): Lecture

Prerequisite(s): FREC 3215, FREC 3216, STAT 5606, STAT 5616

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

Instruction Type(s): Lab, Lecture

Prerequisite(s): null null

Corequisite(s):

FREC 5264:

GIS Applications in Natural Resource Management

Acquiring and using publicly available natural resources data sources. Methods and algorithms for terrain modeling and landscape metrics. Evaluation of the impacts of data errors and variability on analysis results, including sensitivity analysis of GIS-based resource assessments. Special issues related to temporal data and the management of natural resources information systems.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): FREC 4214 OR GEOG 4084

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

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

FREC 5354:

Advanced Forest Soils

Current topics in forest soils with emphasis on soil-site relationships, managing soil water, tree roots and nutrient uptake, diagnosis and correction of nutrient deficiencies, effect of atmospheric deposition on forest soils, and modeling and simulation of nutrient and water movement in forest soils.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): FREC 4354

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 gradute credit. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

FREC 5384:

Forest Biology and Ecology for Educators

This online course is designed to provide educators with an understanding of the specifics of forest ecology and tree biology. Topics include identification of approximately 80 commonly found tree species, tree growth and development, woody plant reproduction and propagation, carbon and water uptake, dormancy and coldhardiness, site productivity and forest succession, forest soils, and silvicultural practices in managed forests. This class is offered online during a 10 week period that extends over both Summer I and II sessions. This course is not available to graduate students enrolled in Forestry 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):

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

Instruction Type(s): Lecture

Prerequisite(s): FREC 3414, FREC 4424

Corequisite(s):

FREC 5454G:

Advanced Urban Community Forestry

Planning, administration, financing, and management of trees, forests, and green scape associated with urban areas and the urban/rural interface. Includes a study of the social needs and values of urban situations; urban tree/forest resource assessments; tree and vegetation ordinances; development, financing and management if tree maintenance programs; community involvement, public relations, and urban forestry education programs. Pre-requisite: Graduate Standing required

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 resouce 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

FREC 5474 (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):

FREC 5494:

Natural Resource Research Procedures

An examination of concepts and philosophies of science and research as applied to forestry and related renewable natural resource research programs. Emphasis is on scientific procedure, ethics, and responsibility. Attention is also paid to the specifics of establishing research projects, contracts, and grants and carrying them out. Consent required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): 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 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FREC 5904:

Project and Report

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FREC 5974:

Independent Study

NONE

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

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

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,.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): (FREC 5254 OR FOR 5254), (FREC 5264 OR FOR 5264), GEOG 5034

Corequisite(s):

FREC 6984:

Special Study

NONE

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

NONE

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;

Associate Professors: Andrew Ellis; Lisa Kennedy; Korine Kolivras; Lynn Resler;

Assistant Professors: Timothy Baird; Luke Juran;

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Geographic patterns of disease and health care at various scales. Ecological, holistic approach to health problems emphasizes interrelationships of population-habitat-culture. Mapping of disease patterns and health services delivery and utilization. Field experience included. 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 5084G:

Advanced Modeling with Geographic Information Systems

Use of automated systems for geographic data collection, diditization, 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):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5114:

Geospatial Programming and Environmental Conservation

Common 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

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 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): GEOG 4354, FOR 4214

Corequisite(s):

GEOG 5134G:

Advanced Water, Hazards, and Development

Geographical analysis of water as a hazard upon human (infrastructure, economy) and natural (rivers, groundwater) systems in the form of hydrometeorological events, water- and vector-borne disease, climate change, dams, and eutrophication. Development of proficiency in demonstrating the 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:

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

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): 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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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:

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

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5364:

GIS Applications in Natural Resource Management

Acquiring and using publicly available natural resources data sources. Methods and algorithms for terrain modeling and landscape metrics. Evaluation of the impacts of data errors and variability on analysis results, including sensitivity analysis of GIS-based resource assessments. Special issues related to temporal data and the management of natural resources information systems.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): FOR 4214 OR GEOG 4084

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 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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 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.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): 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 API's, virtual globes, user-centric design, web cartography. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GEOG 5444:

Topics in Physical Geography

Investigatiion 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 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
Instruction Type(s): 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
NONE
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5904:
Project and Report
NONE
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5974:
Independent Study
NONE
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

GEOG 5994:
Research and Thesis
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

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

Instruction Type(s): Lab, Lecture

Prerequisite(s): GEOG 5034, (FOR 5254 OR FREC 5254), (FOR 5264 OR FREC 5264)

Corequisite(s):

GEOG 6984:

Special Study

NONE

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

NONE

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: James Campbell; Laurence Carstensen; Thomas Crawford; Steven Hodges; Randolph Wynne; Carl Zipper;

Associate Professors: Susan Day; Andrew Ellis; John Galbraith; Conrad Heatwole; Marcella Kelly; Lisa Kennedy; Korine Kolivras; Kevin McGuire; Robert Oliver; Lynn Resler; Yang Shao; Valerie Thomas;

Assistant Professors: Timothy Baird; Zachary Easton; Luke Juran; Megan O'Rourke; Meredith Steele; Stephanie Zick;

Research Faculty: William Ford;

General Contact: geospatial@vt.edu

Graduate Site: http://geography.vt.edu/GEA/index.html

Student Handbook: http://geography.vt.edu/GEA/index.html

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 Wood Science and Forest Products, 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. Department Application Server: Hardware: Dell PowerEdge 2600 Processors: Intel Xeon 2.8Ghz. Internal Storage: 1.8TB internal RAID 5 system External Storage: 21TB = 2 x 10.5 TB external RAID 5 systems Relevant Software's: ArcGIS-ArcInfo complete suite, Erdas IMAGINE, ENVI & IDL, Trimble Pathfinder, GPS correction extension for ArcGIS, GPS Analyst, Visual Studio , SAS JMP, SURFER, GPS Utilities (for the Garmin GPS units) Geography Department Lab: Hardware: 18 Dell Optiplex 990 Processor: INTEL I5, 3.6 GHz Ram: 8 GB per system Internal Storage: 500 GB Relevant Software's: ArcGIS-ArcInfo complete suite, Erdas IMAGINE, ENVI & IDL, Trimble Pathfinder, GPS correct extension for ArcGIS, GPS Analyst, Visual Studio, SAS JMP, SURFER, GPS Utilities (for the Garmin units) 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: high end 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 8 Trimble Juno (differential correction is supported) 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 Additional Departmental Resources Type: Large format Scanner Make: VIDAR Designer 18e Ijet Operating System: Windows XP Professional Hardware: Dell Optiplex 745 Processor: 2.8 GHz 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, Quantitative, Analytical

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 13 hours of classes that provide training in advanced research techniques, statistical and spatial analysis, and discussion of contemporary issues in GIS and remote sensing. The second area of coursework requires the selection of 12 hours of electives in geospatial classes involving both GIS and remote sensing. The third area involves 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 approved graduate coursework taken at Virginia Tech prior to enrolling in this program and up to 15 hours of coursework from another university.

NATURAL RESOURCES

Michael Mortimer, Program Director

Professors: Robert Hull; Patricia Raun;

Adjunct Professors: Megan Draheim; Daniel Marcucci; Jennifer Wills;

Affiliated Faculty: Kieran Lindsey; Michael Mortimer; David Robertson;

MNR Info: cligs@vt.edu

MNR Degree: http://cligs.vt.edu/graduate-degree-programs/

Graduate Certificates: http://cligs.vt.edu/certificates/

The Master of Natural Resources (MNR) degree and related graduate certificates prepare students for employment and career opportunities in environmental conservation and sustainable development, especially new jobs emerging in an increasingly global, urban, and interconnected world. Designed as a professional degree, the MNR is offered in Online and Executive formats to meet the needs of our diverse student audience. The MNR is a 30-credit, non-thesis degree that provides an interdisciplinary perspective, transformative experiences, and international engagement as core elements of the curriculum. The MNR degree does not require a GRE for admission, and there are no additional costs for out-of-state or international students. Unsure about a full Masters degree program? Or maybe you would like to take a few courses before you decide? Graduate certificates are a great way to earn academic credit and receive formal recognition for coursework without committing to a full degree program. We offer two graduate certificates: GC in Natural Resources (GCNR), and GC in Global Sustainability (GCGS).

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 organizations 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)

The Master of Natural Resources (MNR) graduate degree requires 30 credit hours and is offered in Online and Executive forms. See the weblink below for details. Master of Natural Resources Graduate Certificates are offered in two formats: Natural Resources (GCNR) and Global Sustainability (GCGS). See the weblink below for details. Graduate Certificates

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 5044:

Environmental Conservation and the American Landscape

Comprehensive examination of American attitudes toward the environment and the history of efforts to protect it, from early European settlers to conservationists of today. History of the U.S. Forest Service and the National Park Service, as well as other federal and private land and resource conservation entities. Concept of wilderness, particularly within national parks and forests. Definitions of the American environment in the context of national development and our evolving strategies of environmental conservation. Primarily taught at National Capital Region. 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 5114:

Global Issues in Natural Resources

Study of the global economic and environmental consequences of the use of renewable natural resources. Emphasis on the world's forest, fisheries, and wildlife resources and on sustainable management. Seeks to enhance knowledge and understanding of the world's natural resources and the management of related industries from a global perspective.

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 5344:

Natural Resources Law and Policy

In-depth examination of natural resource management laws and policies. Operation of laws, historical, and philosophical underpinnings. Emphasis on laws specific to wildlife, public lands, international policies, and scientific aspects of natural resource policy. All sources of law, including treaties, statutes, regulations, Executive Orders, and case law will be utilized, with a strong emphasis on U.S. federal law. 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 5384:

Wetland Ecology and Policy

Examination of the relationship of hydrology, soils, and vegetation to wetland ecosystem processes and the value of wetland functions. Evaluate wetland definitions and classification. Explore decisions toward protecting, restoring, impacting and mitigating wetlands. Assess federal, state and local regulations for wetlands. Graduate stading 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 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 5614G:

Advanced Watershed Assessment, Management, and Policy

Multidisciplinary perspectives of assessment, management, and policy issues for protecting and improving watersheds ecosystems. Topics include: monitoring and modeling approaches for assessment, risk-based watershed assessment, geographic information systems for watershed analysis, decision support systems and computerized decision tools for watershed management, policy alternatives for watershed protection, urban watersheds, and current issues in watershed management. Pre: Graduate standing.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture
Instruction Type(s): 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 5684:

Foundations of Federal Land Management

Provides the framework for public land laws and policies development. Reviews the origins and status of significant laws and policies affecting federal land management, including the evolution to present and impacts. Emphasis is placed on legal concepts, critical analysis, and problem solving. Includes student interactions with land management agencies and with professional 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):

NR 5714:

Ecosystem Management

Problem-based learning format to explore the application of ecological, economic, social, and management principles to natural resource management. Examines the changes in social values, technologies and demographics driving the ecosystem management model. Contrasts how the major federal agencies and other organizations implement ecosystem 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):

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 5834:

Ecological Economics

Fusion of ecology and economics to assess the sustainability of economic policies. The economic system as an evolutionary function of the physical and biological environment. Effects of human economies on the environment and natural resources. Economic growth theory and policy in relation to sustainability of human society and management of natural resources. Distribution of wealth and allocation of resources. Primarily taught at National Capital Region. 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): (BIOL 2804 (UG) OR BIOL 2804), (FOR 3424 (UG) OR FOR 3424)
Corequisite(s):

NR 5854:

Natural Resources Communication Applications

Analysis of current communication theories and strategies used to address natural resource issues, how to evaluate these strategies, and elements necessary for successful communication programs. Students apply communication theories and models to a variety of complex natural resource 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):

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
Instruction Type(s): 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

NONE
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

NONE
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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

NR 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NR 5994:

Research and Thesis

NONE

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

Instruction Type(s): Lab, Lecture

Prerequisite(s): GEOG 4354 OR GEOS 4354, (FOR 5254 OR FREC 5254), GEOG 5104 OR (FOR 5104 OR FREC 5104)

Corequisite(s):

ALLIANCE FOR SOCIAL, POLITICAL, ETHICAL, AND CULTURAL THOUGHT

Francois Debrix, Program Director

Emeriti Faculty: Elizabeth Fine; Ann Laberge; Richard Rich; Richard Shingles; Robert Siegle;

Professors: Francois Debrix; Brett Shadle;

Associate Professors: Bettina Koch; Michael Moehler; Rachel Scott;

Assistant Professors: Mauro Caraccioli;

Affiliated Faculty: Onwubiko Agozino; Aaron Ansell; Clair Apodaca; Paul Avey; Mark Barrow; France Belanger; Gabriel Blouin-Genest; Brian Britt; David Brunsma; Nicholas Copeland; Priya Dixit; Arthur Ekirch; Edward Ewing; Matthew Gabriele; Thomas Gardner; James Garrison; Edward Gitre; Carmen Gitre; Heather Gumbert; Anthony Harrison; Bernice Hausman; Matthew Heaton; Karen Hult; Benjamin Jantzen; Caitlin Jewitt; Jason Kelly; James Klagge; Christine Labuski; Robert Leonard; Douglas Lind; Ilja Luciak; Timothy Luke; Marian Mollin; Wayne Moore; Amy Nelson; Scott Nelson; Zhange Ni; Lydia Patton; Joseph Pitt; Luke Plotica; Paulo Polanah; Katrina Powell; Karl Precoda; Anita Puckett; Besnik Pula; Patrick Roberts; John Ryan; Michael Saffle; Emily Satterwhite; Andrew Scerri; Peter Schmitthenner; Helen Schneider; Paula Seniors; Robert Stephens; Max Stephenson; Ioannis Stivachtis; Gresilda Tilley-Lubbs; Gerard Toal; Peter Wallenstein; Edward Weisband; Laura Zanotti;

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 5124:

Rel and Modernity in the West

A study of the relationship between religion and modernity in the West, with analysis of whether modern scoiety 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:

Islamic Political Thought

The course will review the most significant elements of Islamic political thought throughout Islamic history: the teaching of the Qur'an, 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

Instruction Type(s): 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

Instruction Type(s): 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 stading required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 constrats 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

NONE

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

NONE

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

NONE

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 reserach 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:

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. Pre-requiste may be substituted for any equivalent 5000 level international course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

ASPT 6224:

Distributive Justice

Influential contemporary theories of distributive justice. Social, political, ethical, and cultural dimensions of distributive questions. Utlitarianism, 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ASPT 6984:

Special Study

NONE

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

NONE

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

Robert Denton, Head

Emeriti Faculty: Edward Sewell;

Professors: Robert Denton; William Hopkins; Jim Kuypers; John Tedesco;

Associate Professors: Rachel Holloway; Jennifer Mackay; Beth Waggenspack;

Assistant Professors: Katherine Haenschen; Michael Horning; Adrienne Ivory; Nneka Logan; Natalia Mielczarek; Marcus Myers; Stephanie Smith; Daniel Tamul; Brandi Watkins; Chelsea Woods;

W. Thomas Rice Chair: Robert Denton;

Graduate Contact: comm@vt.edu

Department of Communication: https://commgradvt.wordpress.com/

Graduate Facebook: https://www.facebook.com/commvtgrad/

The Master of Arts in Communication at Virginia Tech is a research-driven graduate program offering courses in strategic communication and media, technology, and society. We prepare graduates to pursue communication doctoral studies, research positions in industry, and advanced teaching or professional careers. Our program blends social-scientific and humanistic research with communication theory in the areas of strategic communication and media, technology, and society. Students are introduced to a diverse theoretical and methodological perspectives, with a focus on research in every class. Faculty strengths in digital, political, strategic, rhetorical, and organizational communication enrich student learning and career readiness. Students engage in reviewing and discussing communication research, collecting and interpreting original data, and synthesizing and presenting communication knowledge to educate others. Degree completion includes a thesis, where students research an area/question of communication interest in depth, using either a qualitative or a quantitative methodology. If you aspire to achieve a Ph.D., a thesis hones research skills in a focused area of interest. If your goal is a professional career, a thesis promotes your ability to conceptualize and to complete a research project from start to finish. We strongly encourage graduate students to attend regional and national conferences to present their work. Full and partial funding opportunities for conference travel are available. The program boasts a nearly 100% placement rate at top Ph.D. departments for graduates interested in pursuing doctoral study. Those planning a professional career typically are employed within four months. Communication M.A. students are active researchers, provide university and community service through the Communication Graduate Students Association (CGSA), and establish a Hokie community of friends and colleagues.

For Fall admission and consideration for graduate funding (serving as a departmental graduate teaching assistant), the electronic application must be completed by January 19. First round decisions are made early in February. Second-round applications (excluding GTA funding requests) are accepted until April 15. Detailed information about the program's goals, funding opportunities, faculty, and application procedure, may be found at https://commgradvt.wordpress.com/.

SPECIAL FACILITIES

Our research facilities consist of several experimental and observation rooms. The Virginia Tech Gaming and Media Effects Research Laboratory (VT G.A.M.E.R. Lab) is housed in Shanks Hall 033. The lab resembles a living-room setting and facilitates research investigating the social effects of video games and related media technology. Under the direction of associate professor Dr. James D. Ivory, the lab conducts numerous research projects each year and hosts several research colloquia during spring semesters. Research equipment contained in the labs includes the Biopac MP35 system with peripherals to measure skin conductance (EDA), electrocardiogram (ECG), facial electromyogram (EMG), electroencephalogram (EEG), noninvasive blood pressure, and push-button reaction time tasks. The research facilities also house Perception Analyzer real-time-response equipment, multiple large plasma-screen monitors, multiple video game console systems, multiple presentation systems, networked laptop computer system, and dedicated internal wireless servers. We also have an open space room where most group-administered research projects, such as computer-assisted experiments and surveys, focus groups, and projects using the Perception Analyzer, are conducted. The facilities include a two-way mirror, an observation room, and multi-purpose rooms designed to accommodate research projects involving individual or small groups of research participants.

Communication research facility

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plasma-screen monitors, multiple video game console systems (e.g., PS2, Xbox360, Nintendo Wii, PS3), multiple presentation systems, networked laptop computer system, and dedicated internal wireless servers. We also have an open space room where most group-administered research projects, such as computer-assisted experiments and surveys, focus groups, and projects using the Perception Analyzer, are conducted. The facilities include a two-way mirror, an observation room, and multi-purpose rooms designed to accommodate research projects involving individual or small groups of research participants.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL
GRE

General: Verbal (150.0), Quantitative (150.0), Analytical (4.0)

All graduate students receiving the M.A. degree in Communication must complete 33 credit hours. Required coursework includes 9 hours of core subjects (Communication Theory, Communication Research Methods, and Rhetorical Theory & Criticism), 15 hours of additional Communication coursework, and at least 3 hours of electives. In addition, successful completion of the program's ethics requirement is necessary. All students must complete the M.A. degree with thesis (6 hours). In addition, each graduate student must pass a final oral thesis defense administered by the student's advisory committee as well as a public presentation of thesis findings.

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s): COMM 5024

COMM 5024:

Communication Research Methods

Advanced treatment of a variety of research related issues germane to the discipline of communication studies. Topics include the scientific method; elements of the research process; experimental, quasi-experimental, and non-experimental research designs; and legal and ethical issues in research. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s): COMM 5014

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): COMM 5024

Corequisite(s):

COMM 5414:

Mass Media Effects

Explores major areas of theoretical study of mass communication and the social impact of mediated messages.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

COMM 5444:

New Communication Technology

Explores the social implications surrounding the design, production, use,

and evaluation of communication technology. Emphasis is on how communication functions in the creation and use of technology, and how communication and other social factors may be influenced by technology.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5454:
Mass Media Theory
Survey of theory related to the production, content, form, consumption, effects, and social role of mass media. Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5494:
Topics in Media, Technology, and Society
Variable topics in studies of media, technology, and society. Social, political, and economic impacts of media and technology on audiences, contexts, issues, resources, and policy. Theoretical and methodological approaches to study of media and technology. May be repeated for credit, with different content, for a maximum of 9 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):

COMM 5514:
Public Relations Theory and Practice
Examines fundamental theory and research in public relations, including systems theory, symbolic interactionism, organizational theory, cognitive processing and persuasion; models of public relations practice; ethics.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5524:
Organizational Communication
Theory and application of communication in organizational settings. Graduate standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5534:
Crisis and Issue Management
Characteristics and uses of crisis and issue management as communicative resources for organizations. Contributions of public relations practice in the creation of systems of meaning, oublic policy, and distribution of symbolic and tangible resources. Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5564:
Persuasion and Social Influence
Examines fundamental theory and research on persuasion and social influence. Emphasis on a broad-based perspective, encompassing the full scope of persuasion as it is found in everyday life. This course examines persuasion in a variety of contexts and settings, including advertising, small groups, and face-to-face encounters.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5594:
Topics in Strategic Communication
Variable topics in studies of strategic communications. Deliberative communication practice on behalf of organizations, corporations, causes, and/or social movements. Impact of internal and external audiences, contexts, issues, delivery platforms, resources, technology,

and policy. May include theories of persuasion and social influence, media impact, and public opinion. May be repeated for credit, with different content, for a maximum of 9 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):

COMM 5614:

Rhetorical Theory and Criticism

Survey of theories of rhetoric. Focuses on the multiple conceptions of rhetoric through history and the critical methods emerging from rhetorical theory.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5634:

Social Movement Campaigns

Communication theories and methods of studying social movement campaigns. Rhetorical construction of social protest. Graduate standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

COMM 5714:

Corporate Communication for Business Managers

Public relations as a business management function. Strategic role of public relations in building corporate reputation and protecting goodwill, executive and organizational image, communication strategy, corporate social responsibility, ethical and legal communication practices, media relations, community relations, employee communication, investor relations, government relations, and crisis communication. For MBA students. 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):

COMM 5814:

Seminar in Communication Studies

Topical seminar examining various aspects of contemporary theory and research in interpersonal, public, and mediated human communication. Repeatable with different content for a maximum of six hours credit.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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

NONE
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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

COMM 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CREATIVE WRITING

Bernice Hausman, Chair

Professors: Edward Falco; Nikki Giovanni; Robert Hicok; Lucinda Roy; Carmen Smith;

Associate Professors: Jeffrey Mann; Erika Meitner; James Vollmer;

Assistant Professors: Evan Lavender-Smith;

Affiliated Faculty: Gyorgyi Voros;

University Distinguished Professor: Nikki Giovanni;

Alumni Distinguished Professor: Lucinda Roy;

Graduate Contact: meitner@vt.edu

Graduate Contact: sashupe@vt.edu

Graduate Site: https://liberalarts.vt.edu/academics/graduate-programs/master-of-fine-arts-in-creative-writing.html

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 in Shanks Hall.

DEGREES OFFERED

MFA Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The MFA in Creative Writing is designed to be completed in three years. Students may specialize in Fiction or Poetry. A minimum of 48 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 48 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).Composition Pedagogy: 8 hours.Editing a Literary Journal (5774): 3 hours (though students are required to take this course twice, it only counts once towards the required 48 credits).Research & Thesis (5994): 6 hours; a book-length creative thesis (a collection of poetry; a collection of short stories, or a novel) Graduate English courses: 9 hours; students may use an independent study in Editing a Digital Journal to help fulfill this requirement.Academic Integrity requirement: 1 hour.

EDUCATION, CAREER AND TECHNICAL EDUCATION

William Price, Program Director

Emeriti Faculty: Daisy Cartwright; Konrad Eschenmann; Patrick O'Reilly;

Professors: H Sutphin;

Associate Professors: William Price;

Visiting Faculty: Joseph Mukuni;

Affiliated Faculty: Thomas Broyles; Rickie Rudd; Donna Westfall-Rudd;

General Contact: wprice@vt.edu

Graduate Site: http://www.soe.vt.edu/cte/index.html

Program Director: William Price Graduate Program Director: Nancy Bodenhorn Emeriti Faculty: Daisy Cartwright; Konrad Eschenmann; Patrick O'Reilly Professors: H Sutphin Associate Professor: William

Price Visiting Assistant Professor: Joseph Mukuni Education, Career and Technical Education Introduction The Career and Technical Education (CTE) program at Virginia Tech is one of the top CTE graduate programs in the United States. U.S. News and World Report has consistently ranked the program as one of the top 10 CTE graduate programs for the past 15 years. 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 a doctoral degree (Ph.D. or Ed.D.). 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 educators 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. 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

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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.

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. Please see the CTE program web site and consult an advisor for specific information.

EdD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The Ed.D. degree in Curriculum and Instruction with CTE concentration requires a minimum of 90 credits beyond the bachelor's degree. Please see the CTE program web site and consult an advisor for specific information.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

The Ph.D. degree in Curriculum and Instruction with CTE concentration requires a minimum of 90 credits beyond the bachelor's degree. 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 firm's 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

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

EDCT 5624:

Managing CTE Program

Responsibilities of the career abd 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. 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):

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 teacher's 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
Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5764:

Externship in Education

Problem-solving clinics for experienced career and technical education practitioners who are engaged part-time in graduate study while continuing in positions of leadership. Involves systemic analysis of current educational problems and evaluation of educational practice. (Max 12C).

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

Instruction Type(s): 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

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDCT 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCT 5964:

Field Study

NONE

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

NONE

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

NONE

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

NONE

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 6614:

Evaluation in Career and Technical Education

Study of the theory and application of evaluation to career and technical education. Major emphasis on the unique requirements of program, personnel and student evaluation as specified in Federal and State legislation and regulations. National and state evaluations of career and technical education are assessed.

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCT 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCT 7754:

Internship in Education

NONE

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCT 7964:

Field Studies in Education

NONE

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCT 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDUCATION, COUNSELOR EDUCATION

Gerard Lawson, Program Director

Associate Professors: Nancy Bodenhorn; Laura Welfare;

Assistant Professors: Laura Farmer; Matthew Fullen;

Graduate Contact: glawson@vt.edu

Graduate Site: http://www.soe.vt.edu/counselored/

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 to function as counselor educators, clinical supervisors, or advanced clinicians, through coursework and practical training. 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, and/or Clinical Practice. Doctoral students in the Virginia Tech program have access to the latest instructional technologies, 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, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): EDCO 5204 (UG) OR 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

Instruction Type(s): 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 couseling 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

Instruction Type(s): Lecture

Prerequisite(s): (EDCO 5204 (UG), EDCO 5214 (UG), EDCO 5224 (UG)) OR (EDCO 5204, EDCO 5214, EDCO 5224)

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

Instruction Type(s): 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

Instruction Type(s): 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:

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 5554:

Crisis Prevention, Preparedness, and Response

Assessment of school and community climate and principles of personal and community crisis prevention for counselors, teachers, ans school adminstrators. Preparedness strategies appropriate for typical reactions to crises and relevant to special populations. Prepation 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): EDCO 5284 (UG) OR EDCO 5284

Corequisite(s):

EDCO 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCO 5994:

Research and Thesis

NONE

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 master's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6324:

Professional Counselor Education and Supervision

Counselor Education and Supervision (CES) professional responsibilities and diversity issues. Council for Accreditidation 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. Progam 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

Instruction Type(s): Lecture

Prerequisite(s): (EDCO 5214 (UG), EDCO 5224 (UG)) OR (EDCO 5214, EDCO 5224)

Corequisite(s):

EDCO 6454:

Advanced Study in Career Development and Counseling Appraisal

Models and methods of assessment, use of data, approaches to program evaluation, effectiveness of models and treatment strategies, and theories pertaining to the principles and practice of career development and counseling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCO 5254, EDCO 5264

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6484:

Legal and Ethical Issues in Counseling and Consultation

Principles and practices of legal and ethical issues in counseling and consultation as applied to school, community counseling, and/or private practice settings. Discusses the laws, the court system, and court cases that affect counseling and consultation, as well as the sources and parameters of ethical behaviors. Examines the objectives and practices of ethical codes of counseling and consultation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Prerequisite(s):

Corequisite(s):

EDCO 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCO 6984:

Special Study

NONE

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 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCO 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDUCATION, CURRICULUM AND INSTRUCTION

Emeriti Faculty: Susan Asselin; John Burton; Daisy Cartwright; Patricia Kelly; Susan Magliaro; David Moore; Mark Sanders; Thomas Sherman; Richard Stratton; Josiah Tlou; Terry Wildman;

Professors: Bonnie Billingsley; Katherine Cennamo; Peter Doolittle; James Garrison; George Glasson; David Hicks; Brett Jones; Barbara Lockee; H Sutphin; Jesse Wilkins;

Associate Professors: Mary Barksdale; Brenda Brand; Bettibel Kreye; William Price; Gresilda Tilley-Lubbs; Thomas Williams;

Assistant Professors: Bradley Bowen; Kenneth Potter; Takumi Sato;

Visiting Faculty: Joseph Mukuni;

Affiliated Faculty: Liesl Baum Walker; Thomas Broyles; Charles Burnsed; Edward Ewing; John Moore; Rickie Rudd; James Washenberger;

Instructor(s): Kenneth Potter;

General Contact: nanboden@vt.edu

School of Education: http://www.soe.vt.edu/index.php

The Curriculum and Instruction graduate degrees are offered by 14 programs in the School of Education. Listed below is contact information for all of the programs, followed by degree information for the programs that use the Curriculum and Instruction degrees. The Career and Technical Education (CTE) program has its own Master's Degree and is described in a different section.Career and Technical EducationProgram Leader: Bill Price (wprice@vt.edu, 206 War Memorial Hall, 540-231-7390)Website: www.soe.vt.edu/cte/index.html (See Career and Technical Education for Masters degree information.) Educational PsychologyProgram Leader: Brett Jones (jones1@vt.edu, 319 War

Memorial Hall, 540-231-1880)Website: www.soe.vt.edu/edpsych/index.html Elementary EducationProgram Leader: Mary Alice Barksdale (mbarksda@vt.edu, 307 War Memorial Hall, 540-231-3166)Website: www.soe.vt.edu/elementaryed/index.html English as a Second Language (ESL) and Multicultural Education ProgramProgram Leader: Gresilda (Kris) Tilley-Lubbs (glubbs@vt.edu, 300E War Memorial Hall, 540-231-4658)Website: http://www.soe.vt.edu/esled/index.htmlEnglish EducationProgram Leader: Trevor Stewart (ttstew@vt.edu, 309 War Memorial Hall, 540-231-8335) Website: http://www.soe.vt.edu/englished/index.html Foundations of EducationProgram Leader: Jim Garrision (wesley@vt.edu, 400B War Memorial Hall, 540-231-8331)Website: http://www.soe.vt.edu/foundations/index.html History and Social Science EducationProgram Leader: David Hicks (hicks@vt.edu, 400-A War Memorial Hall, 540-231-8332)Website: http://www.soe.vt.edu/socialstudiesed/ Instructional Design and TechnologyProgram Leader: Jennifer Brill (jmbrill@vt.edu, 300 B War Memorial Hall, 540-231-8328)Website: www.soe.vt.edu/idt/index.html Integrative STEM EducationProgram Leader: Jeremy V. Ernst, 115 War Memorial Hall, (540-231-2040)Website: http://www.soe.vt.edu/istemed/index.htmlMathematics EducationProgram Leader, Secondary Licensure in Mathematics: Betti Kreye (bkreye@vt.edu, 300D War Memorial Hall, 540-231-8348)Program Leader, Mathematics Specialist: Jay Wilkins (wilkins@vt.edu, 300C War Memorial Hall, 540-231-8326)Website: http://www.mathed.soe.vt.edu/ Music EducationProgram Leader: Nancy Bodenhorn (nanboden@vt.edu, 101 War Memorial Hall, 540-231-8180Website: http://www.soe.vt.edu/musiced/index.php Reading Specialist/LiteracyProgram Coordinator: Heidi Anne Mesmer (hamesmer@vt.edu, 318 War Memorial Hall, 540-231-8343)Website: http://www.soe.vt.edu/literacy/index.html Science EducationProgram Leader: George Glasson (glassong@vt.edu, 203 War Memorial Hall, 540-231-8346)Website: http://www.soe.vt.edu/scied/ Special EducationProgram Leader: Thomas Williams (thwilli1@vt.edu, 314 War Memorial Hall, 540-231-8337)Website: http://www.soe.vt.edu/specialed/index.html

SPECIAL FACILITIES

DEGREES OFFERED

EdS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

There are M.A., Ed.S., Ed.D. and Ph.D. degrees offered in Curriculum and Instruction. The specific requirements vary among the programs that award these degrees. Please see information on each program included in the Additional Information section and refer to program web sites for specific requirements.

EdD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

There are M.A., Ed.S., Ed.D. and Ph.D. degrees offered in Curriculum and Instruction. The specific requirements vary among the programs that award these degrees. Please see information on each program included in the Additional Information section and refer to program web sites for specific requirements.

MAEd Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

There are M.A., Ed.S., Ed.D. and Ph.D. degrees offered in Curriculum and Instruction. The specific requirements vary among the programs that award these degrees. Please see information on each program included in the Additional Information section and refer to program web sites for specific requirements.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

There are M.A., Ed.S., Ed.D. and Ph.D. degrees offered in Curriculum and Instruction. The specific requirements vary among the programs that award these degrees. Please see information on each program included in the Additional Information section and refer to program web sites for specific requirements.

GRADUATE COURSES (EDCI)

EDCI 5104:

Schooling in American Society

A study of the people and forces that impact on American education, analyzing the social setting of schooling and the relationships among school, curriculum, clients, personnel, and culture.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

EDCI 5124:

Behavioral Aspects of Music

Behavioral foundations of music research examining the influence of music on the performer and the listener. Perception, reaction, moods, powers of discrimination, and musical acoustics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

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. Pre-requisite: Graduate standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5204:

Elem Sch Curriculum

This course is concerned with the development of the elementary school curriculum. It deals with the structure, characteristics, problems and practices of the elementary school curriculum, the children, the environment and the school setting. The course is also concerned with the process of curriculum improvement and its implementation in contemporary elementary schools.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5214:

Linguistic Theory and Instruction in Reading and Written Expression

Studies the syntactic structure of questions and their function and application to selected questioning strategies in reading and writing; explores ideas for the development of a systematic approach to teaching writing in conjunction with reading; discusses the use of stylistic devices and grammars in a reading and writing program using basal readers and children's literature.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCI 5004 (UG) OR EDCI 5004

Corequisite(s):

EDCI 5224:

Advanced Curriculum & Instruction in Elementary & Middle Sch Social Studies

Emphasizes curriculum research and recent developments in trends and materials in elementary and middle school social studies instruction. Exploration of alternative approaches in instructional strategies. (1-3H, 1-3C).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5234:

Advanced Curriculum and Instruction in Elem & Middle School Mathematics

Research and recent developments in elementary and middle school math curricula; study and analysis of recent trends and materials; and examination of alternative approaches in methodology. (1-3H, 1-3c).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5244:

Advanced Curriculum and Instruction in Elementary and Middle School Science

Selected study and analysis of curriculum trends, methods and materials. Emphasis on recent developments and the practical implications of research in science education. (1-3H, 1-3C).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5264:

Comprehending Processes and Reading in the Content Areas

Explores basic processes involved in comprehension: the role of concepts about text structure, task demands, and the role of the reader; includes teaching strategies for comprehending and using information in content area texts and in job related materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): null null

Corequisite(s):

EDCI 5304:

Assessment for K-12 Literacy Instruction

Examines theory and practice of assessment in literacy education. Explores the range of current paradigms, including those associated with assessment as measurement, as procedure, and as inquiry. Focuses on the reciprocal relationship between assessment and instruction in literacy practices. Explores a variety of assessment practices and their appropriateness for use with a diverse student population.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCI 5004 (UG) OR EDCI 5004

Corequisite(s):

EDCI 5324:

Language, Literacy, and Culture (K-12)

The course assists educators in furthering their understanding of the connection between language, and the role culture plays within literacy development. Emphasizes how educators within the school context (K-12) need to be aware of, and utilize, the cultural background knowledge and linguistic resources, community needs of diverse students, and the community groups in which they belong. Major emphasis is on issues of literacy development in regard to oral, written, and multi-mediated texts. Graduate standing is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5334:

Conducting Literacy Inquiry

Course content develops student skills in analysis of classroom research studies and development of a mind set for becoming a teacher researcher. Familiarizes students with classroom research methodologies that provide the practitioner with skills for conducting a teacher research project within school contexts. 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):

EDCI 5344:

Review of Literary Research

Examines the methods and knowledge developed through the major traditions in literacy research and the social and political forces through which these traditions have been shaped. Graduate 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):

EDCI 5364:

Technology in the Science Classroom

Strategies for effective implementation of technology in science classrooms (K-12) to support student learning. Technology examples include digital resources, software and applications, and internet tools specific to science education. Planning and analyzing the use of technology to support science practices, technology skill development, student assessment, and improving teacher practices. Principles of effective on-line portfolio 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):

EDCI 5374:

Assessment in K-12 Science Education

Roles, types, research, and development of assessments as practiced in inquiry-based science education. Impact of high stakes testing. Principles of aligning assessment with standards of learning and lesson objectives with goal of assessment as a tool for learning. Pre: Graudate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5404:

Practicum in Clinical Reading

Diagnosis and remediation of reading problems. Each student works with children (K-12) in a clinical setting. The student is responsible for collecting relevant data, designing an appropriate program, carefully monitoring, and communicating progress in formal and informal reporting.

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): (EDCI 5004 (UG), EDCI 5304) OR (EDCI 5004, EDCI 5304)

Corequisite(s):

EDCI 5414:

Theory and Practice for Early Literacy Instruction (PK-3)

Examines language development and early literacy teaching and learning. Explores a wide range of current theories and practices including phonics based and meaning based approaches to teaching. Attends to how curriculum, instruction, and assessment reflect differing agendas for literacy and schooling and different definitions of literacy. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5424:

Theory and Practice in Content Literacy Instruction (3-6)

Focuses on comprehension and literacy development in middle grades. It explores a wide range of paradigms of comprehension and attends to how curriculum, instruction, and assessment are conducted within each paradigm. Special attention is given to socio-cultural and critical perspectives within literacy pedagogy.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCI 5414 (UG)

Corequisite(s):

EDCI 5444:

Teaching Adolescent Readers

Examination of active reading processes, instructional stratgies, and appropriate adolescent literature for teaching both the developmental and the remedial reader in secondary language arts. Admission in a graduate teacher education program or instructor permission required. Pre-requisite: Graduate standing admission into a teacher education program or instructor permission.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5454:

Teaching Composition

Investigation of theory and research into pedagogy in teaching composition in K-12 settings. Consideration of the reasons K-12 students write, the ways the learn to write, and the genres and forms they utilize. Pre-requiste: Graduate standing, admission into a graduate teacher education program ro instructor permission.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5524:

Behavior Management in K-12 Classrooms

Analysis and application of research-based instructional and behavioral techniques for supporting individuals in the K-12 classroom. Trends, assesment, ethics, and collaborative involvement in behavior management. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s):

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

EDCI 5554:

Educating Exceptional Learners Across the Lifespan

Analysis of purpose, rationale, and foci of educational programs, and related services for individuals with special needs. Identification of characteristics associated with each exceptionality. Review of procedures for assessment, eligibility decisions, and the development of individualized educational programs. Overview of selected instructional strategies, environmental adaptations, and special materials. Examination of findings concerning program efficacy.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDCI 5555:

Reading Specialist Practicum

The practicum develops the skills necessary to enhance school-based learning communities focused on literacy development (K-12) by providing professional development opportunities for teachers and paraprofessionals. The first of the sequence of two courses details the planning process of designing a literacy program within a school context that will identify and provide resources for teachers, administrators, and parents. The second course in the sequence provides the opportunity to implement and assess the literacy plan and to communicate the purposes of the literacy plan to policy makers and the community. Graduate 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):

EDCI 5556:

Reading Specialist Practicum

The practicum develops the skills necessary to enhance school-based learning communities focused on literacy development (K-12) by providing professional development opportunities for teachers and paraprofessionals. The first of the sequence of two courses details the planning process of designing a literacy program within a school context that will identify and provide resources for teachers, administrators, and parents. The second course in the sequence provides the opportunity to implement and assess the literacy plan and to communicate the purposes of the literacy plan to policy makers and the community. Graduate 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):

EDCI 5614:

Topics for In-Service Teachers

Various topics in mathematics and its applications to real-life problems, presented in light of contemporary instructional technologies and standards of learning. The course is designed for in-service mathematics teachers at the high and middle school levels and is suitable for recertification credit. The specific topics covered will be tailored to the location and delivery mode of the course, as well as evolving standards and methodology. May be applied toward graduate degrees in mathematics. In-service status 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):

EDCI 5704:

Contemporary Issues in Music Education

Selective study and analysis of historical and recent curriculum trends and materials; discussion and evaluation of research. Focus on socio-cultural, equity, philosphical, learner-centered, curriculum, assessment, technology, and critical pedagogical prespectives within K-12 music education. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

EDCI 5724:

Teaching in Middle and Secondary Schools I

Introduces concepts and methods that enhance the teaching of specific academic disciplines (English, history and social sciences, science,

mathematics, foreign languages, and music) in combination with a field studies course. 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):

EDCI 5744:

Teaching in Middle and Secondary Schools II

Intensive instruction in methods of teaching an academic discipline (English, history and social science, science, mathematics, foreign languages, and music). Emphasis on classroom management, use of instructional technology, planning and delivery. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

EDCI 5754:

Internship in Education

Student participation in a planned clinical experience under supervision of a university staff member in an appropriate work center.
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):

EDCI 5764:

Externship in Education

Special interdisciplinary problem-solving clinics for experienced educational practitioners who are engaged part-time in graduate study while continuing in positions of leadership in education. Interdisciplinary teams of faculty work with small groups of experienced supervisors or instructors in systematic analysis of current educational problems and evaluation of educational practice. Students judged on quality of their investigations, individual reports, and discussion. (Maximum 12C). Consent required.
Credit Hour(s): 1 TO 12
Lecture Hour(s): 1 TO 12
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

EDCI 5774:

Problems in Education

Study of problems of professional educators in such areas as supervision, instruction, and curriculum development.
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):

EDCI 5784:

Graduate Seminar in Education

Selected topics in curriculum and instruction, supervision, educational foundations, special education, research, and evaluation.
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):

EDCI 5804:

STEM Education Foundations

Provides an introduction to the nature of the science, technology, engineering, and mathematics (STEM) disciplines, and their corresponding STEM education disciplines; the inherent connections, confluences, and differences among the STEM and STEM education disciplines; the frameworks, standards, and infrastructures that govern the teaching of these subjects in K-16 STEM education; and other social, political, theoretical, and philosophical ideas and influences that underlie K-16 STEM education. 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):

EDCI 5814:

STEM Education Pedagogy

Provides an ordered investigation into the instructional practices and signature pedagogies of science, technology, engineering, and mathematics (STEM) disciplines as a means for developing purposefully

integrative approaches for teaching/learning the content of these disciplines. Through study of the epistemologies, philosophies, strengths, and limitations associated with STEM signature pedagogies, students come to know a set of blended pedagogical practices that serve to enhance individual practices within their chosen fields. 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):

EDCI 5824:
STEM Education Trends & Issues
An exploration of contemporary K-16 Science, Technology, Engineeering, and Mathematics (STEM) education trends and issues, including both integrative and within-discipline STEM education trends/issues. Topics addressed include STEM literacy, integrative approaches to STEM education, the changing role of design and inquiry in STEM education, STEM education-related legislation, change theory, state and federal funding, and extracurricular STEM education initiatives. 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):

EDCI 5834:
STEM Education Research
Designed as a structured investigation into the educational research methods and priorities among the science, technology, engineering, and mathematics (STEM) education disciplines. This course examines the various research methodologies used in studying teaching/learning issues within the context of STEM education disciplines. Students examine the similarities, distinctions, and overlaps among questions posed, reaearch designs, and methods of studying best practices in order to better understand the teaching and learning processes among STEM education disciplines. Student gains in their understanding of these processes serve as the framework for preparing individual STEM-related action research proposals. 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):

EDCI 5844:
STEM Education Seminar
An open forum for the exploration of topics and issues reflective of the national educational reform efforts impacting the science, technology, engineering, and mathematics (STEM) disciplines, with particular attention to the broader context of concerns for developing a technologically literate populance within our educational system. Through a blend of readings, presentations, discussions, expeditions, and reflections on personal experiences, students develop an appreciation for STEM discipline perspectives relative to the educational process. 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):

EDCI 5854:
Biotechnology Literacy By Design
Addresses the field of biotechnology through technological design as a core curricular requirement reflective of the national Standards for Technological Literacy (STL) (ITEA, 2000). Using problem/project-based instruction, students develop a level of general science, technology, engineering, and mathematics (STEM) education literacy necessary for K-12 STEM educators to teach about biotechnology from a technological/engineering design approach. Students examine the content areas of biotechnology and apply the technological design method as they explore a variety of purposefully designed integrative instructional strategies for teaching at the intersections of the STEM disciplines. This project-oriented course provides students with the opportunity to apply instructional theories, principles, and practices in the design of authentic problem-based instructional units appropriate for inclusion into the K-12 STEM Education curriculum. 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):

EDCI 5894:
Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5904:

Project and Report

NONE

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):

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. Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 5924:

Research in Educating English Language Learners

Principles of research in the education of English language learners in diverse and multicultural K-12 classrooms and community settings. Analysis of published research and evaluation of discrepancies between practice and research in English language learner populations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDCI 5914 OR EDCI 5914 (UG)

Corequisite(s):

EDCI 5964:

Field Studies in Education

Applied study in one or more educational institutions. Research, evaluation, curricular, and instructional projects are examples of appropriate projects of study. The student is graded on the basis of the design of the project and ability to carry it through and report the results.

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):

EDCI 5974:

Independent Study

NONE

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):

EDCI 5984:

Special Study

NONE

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):

EDCI 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

EDCI 6014:

Advanced Topics in Teacher Education Currilculum

Intensive study of research findings and methods in preservice teacher education. Focus on internal and external issues that affect the curriculum, guidelines, accreditation, governance, alternative models, and approaches, instructional strategies, and history of teacher education reform. May be repeated to a maximum of 6 semester hours. Pre-requisite: Graduate Standing required.

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCI 5104

Corequisite(s):

EDCI 6024:

The Analysis of Educational Concepts

Systematic introduction to the study of contemporary philosophy of education, indicating ways in which philosophy is used to analyze educational aims, content, methods, and values.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCI 5104

Corequisite(s):

EDCI 6034:

Education and Anthropology

Exploration of anthropological ideas and findings relevant to educational institutions and the teaching/learning process. Emphasis on how sociocultural patterns affect what is taught and learned.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCI 5104

Corequisite(s):

EDCI 6054:

Acad Writing for Qual Ed Res

Writing workshop in which students work toward a personal goasl (manuscript, book review, conference proposal, or fellowship application). Emphasis on how writing operates in the production, circulation, and elevation of knowledge in high education. Writing for qualitative research in education is the focus of this course.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDRE 6504

Corequisite(s):

EDCI 6505:

Reading Research Seminar

Issues related to conducting and reporting research on the reading process and reading pedagogy. Includes the critical review of classical and contemporary research and an initiation to the process of conducting reading research. Special attention is given to the analysis and classification of major research paradigms.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (EDCI 5004 (UG), EDCI 5304 (UG)) OR (EDCI 5004, EDCI 5304)

Corequisite(s):

EDCI 6506:

Reading Research Seminar

Issues related to conducting and reporting research on the reading process and reading pedagogy. Includes the critical review of classical and contemporary research and an initiation to the process of conducting reading research. Special attention is given to the analysis and classification of major research paradigms.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCI 6505 (UG) OR EDCI 6505

Corequisite(s):

EDCI 6534:

Ethnographic Methods in Educational Research

Exploration of ethnographic methods for data collection and analysis: theoretical bases, procedures, issues, and applications of this approach in educational research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDCI 6034

Corequisite(s):

EDCI 6944:

Professional Seminar

Presentation and critical discussion of current literature and major topics in curriculum and instruction. Provides students an opportunity to synthesize prior course experiences and to prepare and present a draft dissertation prospectus.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 6984:

Special Study

NONE

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):

EDCI 7754:

Internship in Education

Planned program of advanced clinical practice in education through assignment under direct supervision of an outstanding practitioner for periods of up to two semesters.

Credit Hour(s): 1 TO 24

Lecture Hour(s): 1 TO 24

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 7964:

Field Studies in Education

Advanced applied study in one or more educational institutions. Research, evaluation, curricular, and instructional projects are examples of appropriate projects of study. The student is graded on the basis of the design of the study, ability to conduct the study, and interpret and report the results.

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDCI 7994:

Research and Dissertation

NONE

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):

EDUCATION, EDUCATIONAL LEADERSHIP AND POLICY STUDIES

Carol Cash, Program Director

Emeriti Faculty: Glen Earthman; David Parks; Richard Salmon; Travis Twiford; Wayne Worner;

Professors: Michael Alexander; Carol Mullen;

Associate Professors: Carol Cash; William Glenn;

Assistant Professors: John Gratto; Kami Patrizio;

Visiting Faculty: Ted Price;

General Contact: nanboden@vt.edu

Educational Leadership: http://www.soe.vt.edu/edad/

Program Leader: Carol Cash, ccash48@vt.edu, Virginia Tech Richmond Center, 2810 Parham Road, Suite 300, Richmond, VA 23294) Graduate Program Director: Nancy Bodenhorn, (nanboden@vt.edu, 101 War Memorial Hall, 540-231-8180) Web site: http://www.soe.vt.edu/edad/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 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 60 postmaster's credits for the Ed.D. and 66 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 one course each semester, including each summer session over approximately a three-year period. Coursework includes, but is not limited to, leadership and policy studies, advanced school law, advanced school finance, instructional leadership, administration and supervision of special education, theories of educational administration, community and interagency collaboration, planning educational facilities, and organization and delivery of instructional services. 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 1989 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 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 standards of the Interstate School Leaders Licensure Consortium (ISLLC), the standards of the Educational Leadership Constituent Council (ELCC, the body that reviews leadership programs for the Council for Accreditation of Educator Preparation - CAEP), and over 200 knowledge and skill objectives identified 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, in-baskets, 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 two-way interactive video and electronic courseware 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, including the applicant's superintendent. 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, technological competence, favorable recommendations from the applicant's division superintendent and two others. Two writing samples are required for admission. The first, a sample of the student's best writing, is submitted with the application package. Just prior to the interview, the applicant is asked to write the second, which is a response to an educational issue written in a 30 minute timed period. Faculty members, community members, practicing school leaders, and sometimes teachers serve on the interview committee. Each member of the committee scores each candidate on the criteria. Those with the highest scores 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. Two-way interactive video connects 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 (Roanoke, Southwest Virginia, Hampton Roads, Blacksburg, Richmond, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The Educational Leadership Program offers the M.A.Ed. degree in

Hampton Roads, National Capital Region, Richmond, Roanoke, and Southwest Virginia.   Please refer to the program website for specific requirements.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 (Roanoke, Southwest Virginia, Hampton Roads, Richmond, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The Educational Leadership Program offers the Ed.D. degree in Hampton Roads, National Capital Region, Richmond, Roanoke, and Southwest Virginia. Please refer to the program website for specific requirements.

EdS Degree

Offered In (Roanoke, Southwest Virginia, Hampton Roads, Richmond, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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.

EDUCATION, EDUCATIONAL RESEARCH, EVALUATION

Gary Skaggs, Program Director

Emeriti Faculty: Kusum Singh;

Associate Professors: Serge Hein; Yasuo Miyazaki; Gary Skaggs;

Visiting Faculty: David Kniola;

General Contact: bev@exchange.vt.edu

Graduate Site: http://www.soe.vt.edu/edre/

The Educational Research and Evaluation (EDRE) program in the School of Education at Virginia Tech offers doctoral preparation in the areas of measurement, program evaluation, qualitative research methods, and statistics as they are applied in educational and other behavioral sciences. Students enrolled in the program take a 27 semester hour, core set of courses designed to produce a well rounded educational researcher capable of working in many settings. These courses includes 15 hours in quantitative research methods; 12 hours in qualitative research, mixed methods research, and evaluation. Graduates of the EDRE program are prepared for a faculty position teaching research methods courses in research, testing agencies, institutional research and planning, student and program assessment, or government positions as researchers, evaluators, or administrators of research programs in education or other areas of the behavioral sciences. The degree program is only available on the Blacksburg campus.Faculty members and students in the program primarily conduct research about issues relating to education. Historically, the EDRE program was established in 1971 and was the the first Ph.D. program in educational research in the State of Virginia.   Two semesters of full-time enrollment at the Blacksburg campus is required to complete the degree. A master's degree in a field in education or experience working in a K-12 educational setting or setting doing research and evaluation about educational programs is required for admission. EDRE offers a 9-credit Graduate Certificate in Educational Research.

SPECIAL FACILITIES

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

The Ph.D. program in EDRE requires a minimum of 90 hours of course work beyond the Bachelor's degree. These hours are divided among Research Methods, Electives, Masters/Cognate, and Dissertation Research requirements.

GRADUATE COURSES (EDRE)

EDRE 5404:

Foundations of Educational Research and Evaluation

Research and evaluation in education with emphasis on development of

skill requisite for utilizing research and evaluation studies in practical situations. Applies these skills in exercises related to various research and evaluation 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):

EDRE 5644:
Questionnaire Design and Survey Research in Education
This course provides an overview of survey research for graduate students in education. It covers the process from project formulation and sampling, through instrument design and question formulation, to data processing and report writing. Emphasis will be on questionnaire design, providing students with an opportunity to create and revise their own questionnaire and critique instruments used in educational surveys.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): EDRE 5404 (UG) OR EDRE 5404
Corequisite(s):

EDRE 5674:
Introduction to Mixed Methods
Introducation to Mixed Methods research and evaluation in applied social and behavorial sciences, including education, human development, sociology, and medicine. Mixed methods are used to collect and analyze both qualitive and quantitative data.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): EDRE 5404
Corequisite(s):

EDRE 5974:
Independent Study
NONE
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):

EDRE 5984:
Special Study
NONE
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):

EDRE 6504:
Qualitative Methods in Educational Research I
This course provides an introduction to qualitative research methods. It considers mainstream qualitative research traditions, including case study, phenomenology, ethnography, grounded theory, and participatory research. Students will conduct observations, interviews and basic data analysis.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): EDRE 5404
Corequisite(s):

EDRE 6524:
Qualitative Methods in Educational Research II
This course provides an advanced examination of qualitative inquiry in educational and human science research. It considers theoretical assumptions of major qualitative research traditions and provides students advanced skills in data analysis and representation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): EDRE 6504
Corequisite(s):

EDRE 6534:
Ethnographic Methods in Education
Exploration of ethnographic methods for data collection and analysis; theoretical bases, procedures, issues, and applications of this approach in educational research.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture

Prerequisite(s): EDCI 6034

Corequisite(s):

EDRE 6605:

Quantitative Research Methods in Education I & II

This two-course sequence is designed to provide an overview of basic research design, measurement and statistical concepts in social and behavioral research. Emphasis will be placed on understanding the process of social and educational research in field settings, hands on experience of designing and conducting research and analysis of data. I,II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDRE 5404 (UG) OR EDRE 5404

Corequisite(s):

EDRE 6606:

Quantitative Research Methods in Education I & II

This two-course sequence is designed to provide an overview of basic research design, measurement and statistical concepts in social and behavioral research. Emphasis will be placed on understanding the process of social and educational research in field settings, hands on experience of designing and conducting research and analysis of data. I,II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): EDRE 5404 (UG) OR EDRE 5404

Corequisite(s):

EDRE 6624:

Measurement Theory in Education

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5634

Corequisite(s):

EDRE 6634 (STAT 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

EDRE 6654:

Multivariate Statistics for Applications to Educational Problems

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (STAT 6634 (UG), EDRE 6634 (UG), STAT 6644 (UG), EDRE 6644 (UG)) OR (STAT 6634, EDRE 6634, STAT 6644, EDRE 6644)

Corequisite(s):

EDRE 6664:

Application of Structural Equations in Education

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): EDRE 6634

Corequisite(s):

EDRE 6684:

Instrument Development and Validation

Provides experiences in developing instruments, or tests, that are designed to measure educational and psychological constructs, such as knowledge, skills, attitudes, and traits. Issues and practices relating to construct specification, instrument design and administration, and analysis and summary of validity study data will be emphasized. Must

have EDRE 6606 prerequisite or comparable graduate level statistics course.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): EDRE 6606
Corequisite(s):

EDRE 6694:

Hierarchical Linear Modeling

Provides a conceptual framework of hierarchical linear modeling (HLM), some important statistical theory behind the HLM, and hands-on training for applying HLM technique 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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): EDRE 6634
Corequisite(s):

EDRE 6704:

Evaluation Methods in Education

Principles of evaluation with emphasis on practices applicable to a variety of educational settings. The theoretical and philosophical bases which lead to alternative methodologies. Design and measurement alternatives are considered within the jurisdictional, theoretical, and philosophical contexts.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
Corequisite(s):

EDRE 6744:

Mxd Method Research Dsgn

Provides an introduction to mixed methods research design in the human and behavioral sciences. Students will design and execute a pilot study for a mixed method research project.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Research
Instruction Type(s): Lecture, Online Research
Prerequisite(s): EDRE 6606, EDRE 6504
Corequisite(s):

EDRE 6754:

Advanced Item Response Theory

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): EDRE 6624 OR EDRE 6684
Corequisite(s):

EDRE 6784:

Advanced Issues in Qualitative Research

Provides advanced treatment of important theoretical and methodological topics in the contemporary qualitative literature and in the ongoing development of qualitative methodology. Emphasis is placed on addressing both theoretical issues and issues of research praxis. Topics covered vary from term to term.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): EDRE 6524
Corequisite(s):

EDRE 6794:

Advanced Topics in Educational Research

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.
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 5634
Corequisite(s):

EDRE 6974:

Independent Study

NONE

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):

EDRE 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDRE 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDRE 7964:

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDRE 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ENGLISH

Bernice Hausman, Chair

Professors: Joseph Eska; Virginia Fowler; Thomas Gardner; Peter Graham; Bernice Hausman; Kenneth Hodges; Nancy Metz; David Radcliffe;

Associate Professors: Sheila Carter-Tod; Gena Chandler-Smith; Anthony Colaianne; James Dubinsky; Charlene Eska; Shoshana Knapp; Su Fang Ng; Kelly Pender; Karen Swenson;

Assistant Professors: Katie Carmichael; Katharine Cleland; Chris Lindgren; Ashley Reed; Jennifer Sano-Franchini; Abby Walker;

Alumni Distinguished Professor: Thomas Gardner;

Clifford A. Cutchins III Professor of English: Su Fang Ng;

Edward S. Diggs Professor in the Humanities: Bernice Hausman;

Graduate Contact: sashupe@vt.edu

Graduate Contact: gechandl@vt.edu

Graduate Site: http://www.english.vt.edu/graduate/MA/index.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. 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 February 2. For more information about our Master of Arts degree in English, please consult our website: http://liberalarts.vt.edu/academics/graduate-programs/masters-programs-list/master-of-arts-in-english.html."You think your pain and heartbreak are unprecedented in the history of the world, but then you read. It was Dostoevsky and Dickens who taught me that the things that tormented me most were the very things that connected me with all the people who were alive, or who had ever been alive." --James Baldwin

SPECIAL FACILITIES

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's mission involves studying rhetoric and writing in action, with a particular interest in writers and speakers who face rhetorical challenges related to their social positions and circumstances. We believe, with Jacqueline Jones Royster, that "groups who have honed their crafts at the margins may be the rhetors from whom we can learn and be inspired." We are always looking for new collaborators and graduate assistants. If you have a project that connects with our mission or if you are studying at Virginia Tech and pursuing an advanced degree related to rhetoric, composition, or technical communication, we would be happy to hear from you. 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 http://www.rhetoric.english.vt.edu/. 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

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

The degree requires 36 hours of coursework. All students must take two required courses in Literary Research (5014) and Critical Theory (5024). They must also complete a capstone project, which 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 who wish to focus their coursework on rhetoric and writing studies can pursue the RW track, which requires six hours in RW courses beyond ENGL 5004 for GTAs and twelve hours in RW courses for non-GTAs. http://liberalarts.vt.edu/academics/graduate-programs/masters-programs-list/master-of-arts-in-english.html

GRADUATE COURSES (ENGL)

ENGL 5004:

Theory & Pract Univ Writ Inst

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-requisite: Graduate Standing and appointment as a GTA in the Department of English.

Credit Hour(s): 6

Lecture Hour(s): 4

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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. Pre-requisite: Granduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5224:

Studies in Early English Authors

Rotating studies in the works of such early writers as Chaucer, Shakespeare, or Milton, focusing on their relationship to history; on key texts; on themes or genres; or on critical approaches. Content will vary; may be repeated once for credit. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): null null
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
Instruction Type(s): 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
Instruction Type(s): 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 communicaion influence audiences. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5624:

Intercultural Communication

Examination of theoretical and practical issues pertaining to writing and designing for intercultural and/or international audiences. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ENGL 5654:

Professional Writing Pedagogy

Theoretical and practical aspects of designing and teaching an introductory undergraduate course in technical or business communication in academic or business settings. Students will investigate various methods and materials used to teach written, oral, and visual communication approprate for such courses. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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 and Technology

Analysis of the historical and philosophical development of the field of rhetoric of science and technology through benchmark publications; examination of scientific texts and technologies as objects of rhetorical criticism. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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 Program's 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 maximun of 9 credits. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ENGL 5974:

Independent Study

NONE

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):

ENGL 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ENGL 6304:

Disciplinary Issues in Rhetoric and Writing

Examination of the research questions and methods, theories, body of knowledge, sites of practice, and forums of rhetoric, professional and technical writing, and composition. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ENGL 6314:

Classical Rhetoric 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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, entnographies, qualitative interviews, and field/participant observations. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ENGL 7994:

Research and Dissertation

NONE

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

Jacqueline Bixler, Head

Professors: Jacqueline Bixler; Ronda Watson;

Associate Professors: Elisabeth Austin; Jessica Folkart; Aarnes Gudmestad; Medoune Gueye; Sharon Johnson; Corinne Noirot; Richard Shryock; Sarah Sierra; Fabrice Teulon; Vinodh Venkatesh;

Assistant Professors: Catalina Andrango-Walker; Maria Cana Jimenez; Alexander Dickow;

Alumni Distinguished Professor: Jacqueline Bixler;

Graduate Contact: vinodhv@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 http://www.fll.vt.edu/graduate/ or contact MA.FLCL@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 http://www.fll.vt.edu/graduate/ or contact us at MA.FLCL@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.

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 http://www.fll.vt.edu/graduate/ or contact us at MA.FLCL@vt.edu.

HISTORY

Mark Barrow, Chair

Professors: Mark Barrow; Arthur Ekirch; Edward Ewing; Richard Hirsh; Brett Shadle; Peter Wallenstein;

Associate Professors: Glenn Bugh; Beverly Bunch-Lyons; Heather Gumbert; Matthew Heaton; Kathleen Jones; Marian Mollin; Amy Nelson; Paul Quigley; Helen Schneider; Neil Shumsky; Robert Stephens; Daniel Thorp;

Assistant Professors: Danna Agmon; Carmen Gitre; Edward Gitre; Dennis Halpin; Melanie Kiechle; LaDale Winling;

Robertson Professor of Civil War Studies: Paul Quigley;

Graduate Contact: mheaton@vt.edu

Graduate Site: http://liberalarts.vt.edu/academics/graduate-programs/masters-programs-list/master-of-arts-in-history.html

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: http://liberalarts.vt.edu/academics/graduate-programs/masters-programs-list/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)

GRE

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 gradhist@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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): HIST 5104

Corequisite(s):

HIST 5154:

Writing Skills for the Professional Historian

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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 differet content for a total of 6 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HIST 5224:

Readings in African History

Variable topics readings course focuing 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

Instruction Type(s): 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

Instruction Type(s): 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 enhibits, documentary films, photographic collections, community history projects, the Internet, and a variety of other public venues. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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 the global affairs. Prereqs or instructor's 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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):

HIST 5624:

Jacksonian America and the Civil War

This graduate seminar focuses first on the social, economic, and political events which led to civil war, and then on various aspects of the war itself. Special emphasis also will be placed on the major political and military leaders of the period. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HIST 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HIST 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HIST 5964:

Field Work/Practicum

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HIST 5974:

Independent Study

NONE

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):

HIST 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

HUMAN DEVELOPMENT

April Few-Demo, Interim Head

Professors: Katherine Allen; Joyce Arditti; Karen Roberto; Laura Sands; Pamela Teaster;

Associate Professors: Megan Dolbin-MacNab; Mariana Falconier; Christine Kaestle; Kee Kim; Cynthia Smith;

Assistant Professors: Jeffrey Jackson; Benjamin Katz; Ashley Landers; Bertranna Muruthi; Carolyn Shivers;

Visiting Faculty: Elnora Cunanan;

Research Scientists: Isabel Bradburn;

University Distinguished Professor: Karen Roberto;

Assistant Professor of Practice: Jenene Case Pease;

Graduate Contact: greena15@vt.edu

Department Website: http://www.humandevelopment.vt.edu

All graduate programs in the Department of Human Development 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. The NVC campus is home to the Center for Family Services. 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 and National Capital Region The Department of Human Development 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). Graduate programs are available at both the main campus (Blacksburg, VA; Ph.D. in CAD, ADA, FS, and MFT) and the National Capital Region campus (Falls Church, VA; M.S. in MFT). Goals of Facilities and Resources Programs in the Department of Human Development 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 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

MS Degree

Offered In (National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (151.0), Quantitative (153.0)

The Master's degree program in Marriage and Family Therapy at the National Capital Region campus requires 51-54 credits. The post-master's certificate in Marriage and Family Therapy at the National Capital campus requires 21 credits.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (151.0), Quantitative (153.0)

The Marriage and Family Therapy Ph.D. program at the Blacksburg campus admits students with a master's degree. Students complete a minimum of two years of coursework and one year of internship. The Ph.D. programs 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.Along with required courses, doctoral students participate on research teams, engage in teaching mentorship, and complete a dissertation.

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 I: Individual Development

Introduction to theories and methods used to study adult development and aging. Provides students with a thorough grounding in the scholarly literature in regard to the demographic, biological, functional, psychological, and social aspects of aging with a specific focus on individual development.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): HD 5104

Corequisite(s):

HD 5224:

Social and Emotional Development in Children

Review of research related to social and emotional development of the child from birth through middle childhood. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): HD 5214

Corequisite(s):

HD 5234:

Cognitive Development: Infancy Through Adolescence

Socio-cultural theories, research methods, and empirical issues in cognitive developmetn from infancy through adolescence. Cognitive processes, social cognition, communication, emotion, learners and learning in various social and cultural 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): null null

Corequisite(s):

HD 5244 (PHS 5244) (WGS 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HD 5324:

Marriage and Family Relationships

An introduction to the literature in family studies with emphasis on integration of concepts and current developments in the field.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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.

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. I, II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HD 5614:

Human Development Theory: Literature and Applications

Introduction to major theories of human development and application of these theories to understanding and improving the well being of children, adults, couples, and families within complex social systems. Portfolio

project: Preparation of a theoretically driven literature review. I.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

HD 5624:

Professional Practices in Human Development

Interdisciplinary approaches to professional practices in the delivery of human services. Emphasis on human service delivery to families and communities, management practices, and professional development. Portfolio project: Professional management and leadership assessment. I.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

HD 5644 (PHS 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
Instruction Type(s): 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. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): HD 5614, HD 5624, EDRE 5404
Corequisite(s):

HD 5664:

Internship in Human Development

Provides consultation and seminar dialogue for advanced master's 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 activites 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): HD 5404
Corequisite(s):

HD 5734:

Marriage and Family Therapy Techniques

This course introduces the student ot 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 therapist's 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): HD 5404

Corequisite(s):

HD 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HD 5964:

Practicum

Practicum experiences in departmental options under supervision. (Maximum 15 percent of student's graduate program). Repeatable with different topics.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HD 5974:

Independent Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study

Instruction Type(s): Independent Study

Prerequisite(s):

Corequisite(s):

HD 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HD 6014:

Theory Construction in Human Development

Concepts, principles, and processes of theory construction; paradigms in human development and family studies; development of definitions; assumptions; propositions, and hypotheses; criteria for evaluating theory; and construction of theoretical statements. The pre-requisite EDRE 6605 may be substituted for an equivalent course in research methods and statistics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): HD 5614, EDRE 6605

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HD 6324:

Process In Relationships

Advanced course on process in adult relationships with focus on properties, types, diversity, development, and maintenance of close relationships between adults.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): HD 5324

Corequisite(s):

HD 6404:

Advanced Systems Theory & Family Therapy

Advanced investigation of the development and conceptual basis of systems theory with application to marriage and family therapy. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): HD 6404

Corequisite(s):

HD 6424:

Advanced Experiential Models in Marriage and Family Therapy

Underlying theory and practice of couple and family therapy from experiential therapy models. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): HD 6404, HD 6414

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): HD 6404, HD 6414, HD 6424

Corequisite(s):

HD 6474:

Advanced Professional Seminar In Marriage and Family Therapy

Advanced understanding of the major ethical, legal, and professional issues faced by those in the field of marriage and family therapy. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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: Graudate standing.

Credit Hour(s): 1 TO 4

Lecture Hour(s): 1 TO 4

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HD 7994:

Research And Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PHILOSOPHY

Douglas Lind, Head

Emeriti Faculty: Richard Burian; Harlan Miller;

Professors: James Klagge; Douglas Lind; Joseph Pitt;

Associate Professors: Michael Moehler; Lydia Patton;

Assistant Professors: Sukaina Hirji; Benjamin Jantzen; Kelly Trogdon; Daniel Wodak;

Visiting Faculty: Ted Parent;

Adjunct Professors: James Garrison;

Graduate Contact: tzapata@vt.edu

General Contact: hollymb2@vt.edu

Graduate Program Director: critique@vt.edu

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. We offer core graduate training in philosophy in the broadly analytic tradition, with particular strengths in the history and philosophy of science and in ethics, social and political philosophy. Many of our students enter with the intention of enriching their philosophical background and then going on to Ph.D. studies elsewhere. We have been highly successful in placing our students in leading doctoral programs. Other students simply wish to gain a deeper knowledge of philosophy before going on to other disciplines or professions. In addition to the philosophy M.A., we participate in Ph.D. programs in Science, Technology and Society (which has a philosophy track), and in the Alliance for Social, Political, Ethical, and Cultural Thought.

SPECIAL FACILITIES

The Department of Philosophy has a computer lab for graduate students, as well as office space for all who are currently enrolled. There is also a small library and lounge for graduate student use.

Philosophy Facilities

The Department of Philosophy has a computer lab for graduate students, as well as office space for all who are currently enrolled. There is a small library and lounge for graduate student use.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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 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

Instruction Type(s): 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 own's 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): PHIL 3505

Corequisite(s):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): PHIL 5305

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

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

NONE

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):

PHIL 5984:

Special Study

NONE

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

NONE

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

Instruction Type(s): 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 philosoophy M.A. core courses required. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHIL 6224:

Distributive Justice

Influential contemporary theories of distributive justice. Social, political, ethical, and cultural dimensions of distributive questions. Utlitarianism, 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHIL 6314:

History of the Philosophy of Science

Philosophers of science from 1650 to 1900 with particular attention to the historical development of views about the methods of induction and hypothesis and accounts of theory testing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

POLITICAL SCIENCE

Karen Hult, Chair

Emeriti Faculty: Richard Rich; Charles Walcott;

Professors: Francois Debrix; Karen Hult; Ilja Luciak; Timothy Luke; Edward Weisband;

Associate Professors: Clair Apodaca; Priya Dixit; Bettina Koch; Deborah Milly; Wayne Moore; Scott Nelson; Ioannis Stivachtis; Laura Zanotti;

Assistant Professors: Paul Avey; Gabriel Blouin-Genest; Aaron Brantly; Mauro Caraccioli; Cara Daggett; Nicholas Goedert; Eric Jardine; Caitlin Jewitt; Jason Kelly; Karin Kitchens; Luke Plotica; Besnik Pula; Andrew Scerri;

Visiting Faculty: Brandy Faulkner; Courtney Thomas;

Adjunct Professors: Arnold Dupuy; Adam Newmark;

Affiliated Faculty: Joel Peters; Patrick Roberts; Gerard Toal;

University Distinguished Professor: Timothy Luke;

Edward S. Diggs Endowed Chair in the Social Sciences: Edward Weisband;

General Contact: jenkin04@vt.edu

Graduate Site: http://liberalarts.vt.edu/academics/graduate-programs/masters-programs-list/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 30-50 off-campus in the On-Line 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 on-line 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, 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 computerized 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, 5116-Research Methods II, and 5214-Contemporary Political Theory (total of 9 cr.) and 4 electives (12 cr.).

GRADUATE COURSES (PSCI)

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 5164:

Collaborative Governance and Civil Society

Theoretical foundations of collaborative policy and governance approaches are examined. Strategies and methods for forming and sustaining collaborative coalitions are discussed. Case studies are used to illustrate the effectiveness of collaborative approaches in different 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):

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:

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 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 illustrting 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:

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

Instruction Type(s): 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 (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):

PSCI 5364 (GIA 5364):

Public Ecology

Examines policy developments and practices that move beyond the conceptual divisions and policy operations begun during the 1970's, 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

Instruction Type(s): Lecture

Prerequisite(s): WGS 5114

Corequisite(s):

PSCI 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 People's 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:

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):

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 instructor's 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 (GIA 5504) (UAP 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): GIA 5444 OR UAP 5264 OR PSCI 5444

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 5534:

Regionalism and Political Development

Provides a systematic review of regional organizations, the theories and factors that explain their recent emergence and an analytical framework for studying regional policy objectives such as peace and security, economic growth, environmental protection and the pursuit of human rights. Regional variations between Europe, Latin America, Asia, Africa and the Middle East are examined.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): GIA 5444 OR PSCI 5444

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 globaliztion on women and girls. Impacts of globalization on households and families. Relationship between globalizing processes and gender inequalities. Addresses feminist controversies and women's transnational resistance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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):

PSCI 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:

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 5644:

Women's Rights as Human Rights

International mechanisms for development and protection of women's human rights and their legal, political and cultural dimensions. Methods of strengthening and improving these mechanisms to prevent and respond to women's human rights violations. Pre: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PSCI 5894:

Final Examination

NONE

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

NONE

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

NONE

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

NONE

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:

Critial 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 (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):

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

Instruction Type(s): 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 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. Pre-requiste may be substituted for any equivalent 5000 level international course.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): UAP 5264 OR GIA 5264
Corequisite(s):

PSCI 6214:

Democracy Beyond the Ballot

Forms of ultra or enhanced democracy outside of state institutions, particulary 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
Instruction Type(s): Lecture
Prerequisite(s): GIA 5034 OR UAP 5034 OR PAPA 5034 OR GIA 5164 OR UAP 5164
Corequisite(s):

PSCI 6224:

Competing Conceptions of the Third Sector

Competing theories and conceptions of the third sector in relation to the for-profit firm and the state with international perspectives on voluntary grassroots action challenges and societal transformation. Integration of theoretical and research literatures in the field. Graduate Standing required.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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 fo 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 6544:

Science, Technology, and Labor

Examines issues of work, skill, and power in science and technology. Considers labor issues from a variety of perspectives, including social constructions of expertise; effects of technical change on the organization of work; industrial automation and "deskilling"; race and gender in divisions of labor; "labor-saving" technology in everyday life; "invisible labor" in information systems; and work practices in the production of science. 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):

PSCI 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

RHETORIC AND WRITING

Bernice Hausman, Chair

Professors: Bernice Hausman; Katrina Powell;

Associate Professors: Sheila Carter-Tod; James Dubinsky; Paul Heilker; Kelly Pender;

Assistant Professors: Carolyn Commer; Chris Lindgren; Jennifer Sano-Franchini;

Graduate Contact: kmpowell@vt.ed

Graduate Contact: sashupe@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 from the perspective of rhetoric and writing studies. As faculty at a land-grant university, we seek students who want to engage in research into how rhetoric and writing can contribute to social progress, how literate practices create, circulate, and prioritize societal values and the public policies based on those values, and how rhetoric and writing empower and control access to power in these social systems. Our collective research agenda addresses rhetorical and social problems in such areas as: science and technology digital texts and publishing diversity and difference the environment scholarly inquiry medicine and disability education civic engagement globalized communication and commerce

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/index.html for additional information.

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DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

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, Science and Technology Studies, 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

Daniel Breslau, Head

Professors: Barbara Allen; Gary Downey;

Associate Professors: Daniel Breslau; James Collier; Saul Halfon; Eileen Patzig; Sonja Schmid; Matthew Wisnioski;

Assistant Professors: Ashley Heflin; Rebecca Hester; Philip Olson; Lee Vinsel;

Alumni Distinguished Professor: Gary Downey;

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: (550.0)

iBT: (80.0)

Computer: (213.0)

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: (550.0)

Computer: (213.0)

iBT: (80.0)

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 5014:

Science and the Public

Theoretical and practical aspects of the public's role in the development, application, and oversight of scientific and technological advances.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

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 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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. 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):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 nonprofileration. 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): PHIL 3505

Corequisite(s):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STS 5305

Corequisite(s):

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):

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

STS 5974:

Independent Study

NONE

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):

STS 5984:

Special Study

NONE

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

NONE

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

Instruction Type(s): 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 6314:

History of the Philosophy of Science

Philosophers of science from 1650 to 1900 with particular attention to the historical development of views about the methods of induction and hypothesis and accounts of theory testing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

STS 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

Instruction Type(s): 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 6554:

Energy Policy Hist & Contemp

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 infrstructure. Pre: Graduate standing.

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:

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. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

STS 6834:
Advanced Topics in Social Studies of Science, Technology, and Medicine
Variable topics in social studies of science, technology, and medicine, including studies of disciplines, institutions, boundaries, discourses, knowledges, and practices. 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

STS 6984:
Special Study
NONE
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

SOCIOLOGY

John Ryan, Chair

Emeriti Faculty: Theodore Fuller; Barbara Smith;

Professors: Onwubiko Agozino; David Brunsma; Toni Calasanti; James Hawdon; Michael Hughes; K Kiecolt; Neal King; Wornie Reed; John Ryan; Donald Shoemaker;

Associate Professors: Samuel Cook; Anthony Harrison; Sarah Ovink; Anthony Peguero; Paulo Polanah; Paula Seniors; Anastasia Vogt Yuan; Dale Wimberley;

Assistant Professors: Kaitlin Boyle; Nicholas Copeland; Suchitra Samanta; Donna Sedgwick;

Affiliated Faculty: Karen DePauw; Ellington Graves; Sharon Johnson; Karl Precoda;

Gloria D. Smith Professorship: Anthony Harrison;

Departmental Site: http://www.sociology.vt.edu/

The Department of Sociology at Virginia Tech is a premier, research-oriented program, with 25 full-time faculty members and 6 affiliated faculty. Additional sociologists are faculty members in other departments and programs in the University. Our faculty earned degrees from some of the finest doctoral programs in their fields. They have authored or edited over 60 books on such topics as workplace relations, delinquent behavior, drug use, research methods, Appalachian development, deviance, professional ethics, gender, aging, sociology of knowledge, world systems, household crowding, and the mass media. Departmental faculty have published nearly 650 professional articles and chapters, written over 180 technical reports related to applied sociological issues, and participated in more than 80 externally funded projects. In addition, sociology faculty have received numerous college, university, and national awards for outstanding teaching. Our top-flight education and research focus on critical issues in the United States and the increasingly inter-connected world. A solid grounding in theory and methods constitute the core of our graduate programs. Under our broad umbrella of interests having to do with quality of life, inequality, and work and technology, students specialize in such areas as health, crime/deviance, gender, race, aging, sexuality, and culture. In addition, students may specialize in interdisciplinary Africana Studies or Women's and Gender Studies. Master's students gain the necessary background for doctoral work or careers in applied settings such as business, federal or state government, and social services. Doctoral students establish their own programs of study, engage in their own independent research, teach their own undergraduate classes, present papers at professional meetings, and publish.

SPECIAL FACILITIES

Virginia Tech's Department of Sociology is located in McBryde Hall. McBryde Hall houses exceptional teaching classrooms, and the department provides access to computer labs, faculty and graduate student offices, and administration resources

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (153.0), Quantitative (146.0), Analytical (5.0)

The Master's Degree has three options: Master's Degree, Master's Degree Option with Africana Studies, and a Master's Degree Option with Women's and Gender Studies. Master's students must complete 24 hours of coursework, 6 hours of research, and write a thesis. All M.S. students must pass a final exam. Procedures and requirements for the exam are discussed in the Graduate Catalog and the departmental Graduate Handbook. The examination will be a defense of the thesis and an assessment of the student's understanding of appropriate sociological subjects.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (153.0), Quantitative (146.0), Analytical (5.0)

The PhD has three options: PhD in Sociology, PhD in Sociology Africana Studies Option, and the PhD in Sociology Women's and Gender Studies Option.PhD students must complete 60 hours of coursework and 30 hours of research. If the student has a MS or MA degree from another university, up to 24 hours of coursework taken at another university can transferred in and counted toward the 60-hour requirement. Students are required to have classes in classical and contemporary sociological theory and an advanced theory course. They are also required to have a course in research methods, two graduate-level statistics courses, and an advanced methods or statistics course.Ph.D. Students must also successfully pass a preliminary examination. The examination is to be taken after the student has completed approximately 45 hours of coursework. The preliminary exam is comprehensive in nature and tests a student's ability to integrate, synthesize, and apply sociological concepts in two areas of concentration selected by the student. The exam may also test any aspect of theoretical sociology or research methodology. The student should meet with his or her advisory committee prior to preparing for the exam to discuss the exam and evaluation procedures. The departmental Graduate Handbook discusses these exams in detail.

GRADUATE COURSES (SOC)

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5104:

History of Sociological Thought

Examination of the social thinkers of the classical period in the development of sociological theory (e.g., Marx, Durkheim, Weber, Ward). Particular attention to the theories, methods, and goals developed by early sociologists.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

SOC 5114:

Contemporary Sociological Theory

Focus on sociological theorists since World War II, including Parsons, Merton, Dahrendorf, Coser, Homans, Blau, Blumer, Kuhn, and Garfinkel.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5204:

Data Analysis

Examination of data analysis designs used in sociology with emphasis on the sociological interpretation of different kinds of analyses; practical applications as used in current research. 3 hours of statistics required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5224:

Intermediate Data Analysis

Application of both common and more advanced quantitative data analytical techniques used in sociology and other social sciences, including multiple regression, regression diagnostics, logistic regression, and causal modeling. Emphasis on analysis and interpretation of sociological survey data using SPSS (Statistical Package for the Social Sciences) and presentation of multivariate analyses to a sociological audience.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): SOC 5204

Corequisite(s):

SOC 5234:

Sociological Issues in College Pedagogy

Examines economic, political, and public influences on higher education. Explores the implications of inequality in higher education for institutional change and effective pedagogy. Emphasis placed on the scholarship of teaching and learning, including assessment of pedagogical practices for learning-centered classes. Addresses curriculum development in sociology and techniques for overcoming student resistance in sociology classes. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5324:

Theorizing the African Diaspora

African diaspora theories and their historical foundations. Intersections of dispora 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. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5424:

Juvenile Delinquency Justice

Juvenile delinguency and the juvenile justice system, with particular attention to race, gender, social class, and age. Methods of collecting data and the extent and distribution of juvenile delinquency and juvenile gangs. Theories of delinquent behavior. Effectiveness of the juvenile justice system. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

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. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5654 (GEOG 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 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 sanding 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):

SOC 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5914:

Orientation to the Discipline

Orientation for beginning graduate students to the organization of sociology, with emphasis on historical and departmental program areas and to the perspectives and specialties of departmental faculty; systematic and critical review of roles of sociologists, with particular reference to teaching, writing, professional association participation, and professional ethics.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SOC 5974:

Independent Study

NONE

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):

SOC 5984:

Special Study

NONE

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):

SOC 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

SOC 6204:

Survey Research Methods

Survey research techniques used in sociological research including applied sampling techniques, measurement, scale construction reliability, response effects, administration of survey instruments, data management, and data processing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): SOC 5204, SOC 5214, STAT 4524

Corequisite(s):

SOC 6214:

Sociological Issues in Qualitative Methodology

Examines the key components of qualitative methodology with a focus on sociological debates and issues that are contentious, unresolved, and problematic. Explores different methodological perspectives that are vying for prominence within sociology. Particular attention given to the

role of gender, class, sexualities, age, race, nationality, ethnicity, disabilities, and colonialism in qualitative methodologies. Conduct qualitative research into the broader critque of the methodology including innovative methodologies being developed by qualitative sociologists.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): SOC 5214
Corequisite(s):

SOC 6304:
Social Structure and Personality
Relating social structures and processes to individual personality and behavior. Effects of variables such as social class, religion, race, and gender on social interaction and individual values and attitudes.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): SOC 5204
Corequisite(s):

SOC 6414:
Theories of Crime and Delinquency
Examination of major theories of crime and delinquency, with application to specific examples, such as white-collar crime, gender-based patterns of crime and delinquency, and juvenile gangs. Also covers theories and issues concerning the control and prevention of crime and delinquency.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): SOC 5414
Corequisite(s):

SOC 6504:
The Sociology of Culture
Examination of sociological theory and research on culture, including theories of culture and society; culture as social practice; culture, class and identity; culture and collectivities; culture, power and institutions; the production of culture; cultural reception.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): SOC 5104 OR SOC 5114
Corequisite(s):

SOC 6524:
Sociology of Health
Examination of sociological theory and research on how social structures and social processes influence the health of individuals and populations. Emphasis on the health consequences of social inequalities by race, class, and gender; the effects of social contexts, networks, and institutions on health; and issues in health care.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): SOC 5204, SOC 5214
Corequisite(s):

SOC 6984:
Special Study
NONE
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):

SOC 7994:
Research and Dissertation
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

THEATRE ARTS

Paul Steger, Program Director
Susanna Rinehart, Chair

Professors: Robert Leonard; Patricia Raun; Paul Steger; Randolph Ward;
Associate Professors: John Ambrosone; Patricia Lavender;
Assistant Professors: Amanda Nelson; Jane Stein;
Professor of Practice: Christopher Russo;
Instructors: Joseph Court; Kathryn Murphy;

General Contact: theatreandcinema@vt.edu

Graduate Contact: rhleonar@vt.edu

Design/Tech Contact: rwward@vt.edu

Graduate Site: http://www.performingarts.vt.edu/study-with-us/theatre-graduate

Department Site: http://www.performingarts.vt.edu

The Theatre and Cinema program, in the School of Performing Arts, is a highly successful and innovative program that is fully accredited by the National Association of Schools of Theatre and was the first program in the state to attain that status. The department offers a Master of Fine Arts degree in Theatre Arts, which is designed to train students for professional employment and leadership in the field, while providing a terminal degree in the profession. Areas of concentration include Theatre Design and Technology (scenic, lighting, costume, sound, properties, and technical direction), Directing & Public Dialogue, Arts Leadership, and Stage Management. The M.F.A. program focuses on an individualized plan of study for each student, characterized by one-on-one tutorials or small classes, realized production work, and close mentoring by faculty artists. This is surrounded by a vision of professional training that is most concerned with the formation of a specific attitude toward the artistic process, a way of thinking based on the ever-changing realities of today's arts world. It is a vision grounded in collaboration, relevance, and sustainability, favoring knowledge of current affairs and professional practice within an awareness of our sometimes common, sometimes separate, cultural heritages.Each M.F.A. candidate participates in the mounting of productions in the department, working side by side with faculty and staff. The annual production season generally includes four fully mounted main stage shows, workshop productions, and occasional summer shows. A strong relationship exists with the new Moss Arts Center and the Institute for Creativity, Arts, and Technology (ICAT), where students are provided further experiential opportunities. In addition, students have frequently work on productions outside the department, both on and off campus, locally and beyond. A professional internship also is required for completion of the degree.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. Our graduates have been exceptionally successful in gaining employment upon completion of the degree.Interested persons are encouraged to visit our web site (www.performingarts.vt.edu) to discover more about us.

SPECIAL FACILITIES

The mission and vision of the theatre production program is to produce new and contemporary plays and new visions of the classics to discover how our performances may connect and stimulate people in the many communities on and off the Virginia Tech campus. We find balance in the positive value of human connection - the interaction of mind, imagination, and spirit. As such, we believe that theatre is both a community event and a way to build community. 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 designed by Theatre Arts faculty member Randy Ward. 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 George Izenour designed 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)

Completion of the MFA degree in Theatre Arts requires: - A three-year program of study- A minimum 54 hours graduate credit- A required professional internship for one semester, usually in the third year, with a successful evaluation- A Final Project and Report, or sanctioned alternative (including a thesis option)The core of the curriculum lies in the studio format, one-on-one tutorials and small classes with the student's primary advisor. The educational value of the studio experience is based on regularly planned projects designed as experiential labs. The primary advisor mentors the artistic progress of the student through these projects and guides the development of each student's overarching goals and curricular needs.Each student participates in a required review with graduate committee members at the end of each semester of enrollment to evaluate work done, assess progress, and plan future projects and experiences. A unique Plan of Study, designed to the needs of each student, is developed to track progress toward the degree.

GRADUATE COURSES (TA)

TA 5015:

Graduate Seminar

Special topics in the theory and practice of theatre, current trends, and recent developments. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

TA 5016:

Graduate Seminar

Special topics in the theory and practice of theatre, current trends, and recent developments. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

TA 5316G:

Advanced Directing

Script analysis, theories, techniques, and practical applications of theatircal direction. Rehearsal techniques, style determination realism, and non-realism.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): TA 5315G

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. I,II

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 2 TO 6

Lecture Hour(s): 2 TO 6

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

TA 5615:

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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II
Credit Hour(s): 2 TO 6
Lecture Hour(s): 2 TO 6
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II,III,IV
Credit Hour(s): 9
Lecture Hour(s):
Instruction Type(s): Lab
Instruction Type(s): Lab
Prerequisite(s):
Corequisite(s):

TA 5894:
Final Examination
NONE
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

TA 5904:
Project and Report
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

TA 5974:
Independent Study
NONE
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
NONE
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

AEROSPACE ENGINEERING

Eric Paterson, Head

Professors: Alan Brown; Robert Canfield; William Devenport; Rakesh Kapania; Lin Ma; Eric Paterson; Mark Psiaki; Pradeep Raj; Christopher Roy; Joseph Schetz; Craig Woolsey;

Associate Professors: Jonathan Black; Stefano Brizzolara; Scott England; Mazen

Farhood; Kevin Lowe; Mayuresh Patil; Michael Philen; Gary Seidel; Cornel Sultan;

Assistant Professors: Colin Adams; William Alexander; Seongim Choi; Christine Gilbert; Luca Massa; Bhuvana Srinivasan; Kyriakos Vamvoudakis; Kevin Wang; Heng Xiao;

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;

Fred D. Durham Endowed Chair Professor: Joseph Schetz;

Kevin Crofton Professor: Mark Psiaki;

Graduate Contact: aoe-grad-advising-g@vt.edu

Student Handbook:

http://www.aoe.vt.edu/programs/graduate/forms/AOE_Graduate_P-P.pdf

Graduate Site: http://www.aoe.vt.edu/programs/graduate/index.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. In addition, the Aerospace and Ocean Engineering Department participates in the Systems Engineering interdisciplinary program where students take courses across several engineering departments and outside of the College of Engineering. The requirements for this program are set by the Systems Engineering Advisory Committee and are different from those indicated previously.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 aerodynamics, structures and structural dynamics, flight dynamics and control, ocean engineering, multidisciplinary design, applied mathematics, and applied physics. 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. 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.

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

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 10 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)[1]. 2. A minimum of 12 credit hours (15 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 (9 for non-thesis) 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. All Aerospace Engineering M.S. candidates are required to take: AOE 4404, Applied Numerical Methods; AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; and AOE 5204, Vehicle Dynamics and Control. The following additional required courses pertain to the three areas of specialization. Aero-Hydrodynamics: Thesis (non-thesis) students must take 9 (18) credit hours of approved electives. Electives for thesis students are determined in consultation with the Advisory Committee Chair. Non-thesis aero-hydrodynamics students must take two of the following three courses: AOE 5114, High Speed Aerodynamics; AOE 5135, Vehicle Propulsion; or AOE 5144, Boundary Layer Theory and Heat Transfer. Dynamics and Control: Thesis (non-thesis) students must take 9 (18) credit hours of approved electives. Electives for thesis students are determined in consultation with the Advisory Committee Chair. Non-thesis dynamics and control students must take one of the following two courses: AOE 5754, Applied Linear Systems; or AOE 5744, Linear Systems Theory; and students must take two of the following four courses: AOE 5234, Orbital Mechanics; AOE 5764, Applied Linear Control; AOE 5774, Nonlinear Systems Theory; or AOE 6744, Linear Control Theory. Structures and Structural Dynamics: Thesis (non-thesis) students must take 9 (18) hours of approved electives. Electives for thesis students are determined in consultation with the Advisory Committee Chair. Non-thesis structures and structural dynamics students must take the following two courses: AOE 5034, Mechanical and Structural Vibrations; and MATH 4574, Vector and Complex Analysis for Engineers. 7. All Ocean Engineering M.S. candidates are required to take: AOE 4404, Applied Numerical Methods; AOE 5074, Advanced Ship Structural Analysis[3]; AOE 5104, Advanced Aero and Hydrodynamics; and AOE 5334, Advanced Ship Dynamics. In addition, thesis (non-thesis) students must take 9 (18) hours of approved electives, and non-thesis students must take 6 units of "Project and Report" or complete a 6 unit Capstone Naval Ship Design Project (AOE 5315 and AOE 5316). Electives for thesis students are determined in consultation with the Advisory Committee Chair. Non-thesis ocean engineering students must take two of the following courses: AOE 4024, An Introduction to the Finite Element Method; AOE 4264, Principles of Naval Engineering; AOE 5034, Mechanical and Structural Vibrations; AOE 5084, Submarine Design; AOE 5144, Boundary Layer Theory and Heat Transfer; AOE 5304, Advanced Naval Architecture; AOE 5305, Marine Engineering; AOE 5314, Naval Ship System Design and Effectiveness[4]; AOE 5374, Rationally-Based Design of Ocean Structures; AOE 5434G, Advanced Introduction to Computational Fluid Dynamics; AOE 5444G, Advanced Dynamics of High-Speed Craft; AOE 5454, Advanced Aerospace and Ocean Engineering Instrumentation; and AOE 6145, Computational Fluid Dynamics. 8. If a student has previously taken any of the required courses listed above or equivalent, while a Virginia Tech undergraduate or a student elsewhere, that course must be replaced with another course approved by the Advisory Committee. A student will not be allowed to repeat a Virginia Tech course (or an equivalent course from another institution) for a grade. A required AOE course can only be replaced with another AOE course. Master of Science or Master of Engineering Requirements (AOE, Systems Option) The AOE Department, in conjunction with other interested departments in the College of Engineering, e.g. Industrial and Systems Engineering, offers an interdisciplinary degree in Systems Engineering. The requirements for the degree are essentially the same as those outlined above with the exception of the interdisciplinary aspect of the curriculum, which will be prescribed by the student's Advisory committee consisting of faculty from the AOE Department and the other relevant departments. [1] Non-thesis Ocean Engineering M.S. candidates may take both AOE 5315-5316: Naval Ship Design to meet the 6 unit Capstone Naval Ship Design Project in place of 6 units of AOE 5904: Project and Report. [2] It is strongly recommended that students who wish to take AOE 6744, first take AOE 5744, Linear Systems Theory or an equivalent course on linear, time-varying systems. [3] If AOE 4274: Computer-Based Design of Ocean Structures has already been taken, then one of the following two courses must be substituted: AOE 5024: Vehicle Structures or AOE 5374: Rationally-Based Design of Ocean Structures. [4] It is strongly recommended that students who wish to take AOE 5314: Naval Ship System Design and Effectiveness, first take AOE 4264: Principles of Naval Engineering.

MEng Degree

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GRE

General Test: Verbal, Quantitative, Analytical

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 15 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 9 credit hours of 5974 and 5984 is allowed. 6. 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. 7. A minimum of one approved math course is required. 8. All M. Engr. candidates are required to take: AOE 4404, Applied Numerical Methods; AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; AOE 5204, Vehicle Dynamics and Control; and One additional AOE 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 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. 9. 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). Master of Science or Master of Engineering Requirements (AOE, Systems Option). The AOE Department, in conjunction with other interested departments in the College of Engineering, e.g. Industrial and Systems Engineering, offers an interdisciplinary degree in Systems Engineering. The requirements for the degree are essentially the same as those outlined above with the exception of the interdisciplinary aspect of the curriculum, which will be prescribed by the student's Advisory committee consisting of faculty from the AOE Department and the other relevant departments.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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. 3. A minimum of 27 credit hours of graded course work numbered 5000 or above must be included. 4. A maximum of 18 credit hours of Independent Study (5974) and Special Study (5984) may be included. 5. A maximum of 4 credit hours may be seminars (unstructured courses), not including AOE Graduate Seminar (AOE 5944). 6. 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 15 credit hours of course work (not including AOE 7994) must be earned while in residence. 7. Transfer credit hours may not exceed 50% of graded graduate level credit hours numbered 5000 or higher needed to satisfy the requirements for a Ph.D. (as described below) and are 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. 8. All Ph.D. candidates are required to complete selected courses. Some of the courses are required prior to taking the Preliminary Written Examination and the remaining courses are required prior to completion of the degree. The following additional courses are required according to the area of specialization: Aero-Hydrodynamics i. Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; AOE 5114, High Speed Aerodynamics; AOE 5135, Vehicle Propulsion; AOE 5144, Boundary Layer Theory and Heat Transfer; and AOE 5204, Vehicle Dynamics and Control. ii. Before taking the Final Examination: AOE 5454, Advanced Aerospace and Ocean Engineering Instrumentation; One of the following courses: AOE 5434G, Advanced Introduction to Computational Fluid Dynamics; AOE 6145, Computational Fluid Dynamics; or AOE 6434, Computational Fluid Dynamics and Heat Transfer; AOE 6114, Transonic Aerodynamics; and Any two of the following courses: AOE 6124, Hypersonic Aerodynamics; AOE 6154, Turbulent Shear Flow; AOE 6174, Computational Plasma Dynamics; or AOE 6444, Verification and Validation in Scientific Computing. Dynamics and Control i. Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; AOE 5204, Vehicle Dynamics and Control; One of the following two courses: AOE 5754, Applied Linear Systems; or AOE 5744, Linear Systems Theory; and Two of the following three courses: AOE 5234, Orbital Mechanics; AOE 5774, Nonlinear Systems Theory; or AOE 6744, Linear Control Theory[1]. ii. Before taking the Final Examination, courses determined in consultation with the Advisory Committee. Ocean Engineering i. Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; AOE 5074, Advanced Ship Structural Analysis[2]; AOE 5104, Advanced Aero and Hydrodynamics; and AOE 5334, Advanced Ship Dynamics. ii. Plus any two of the following: AOE 4024, An Introduction to the Finite Element Method; AOE 5034, Mechanical and Structural Vibrations; AOE 5144, Boundary Layer Theory and Heat Transfer; AOE 5434G, Advanced Introduction to Computational Fluid Dynamics; AOE 5444G, Advanced Dynamics of High-Speed Craft; AOE 5744, Linear Systems Theory; ESM 5314, Intermediate Dynamics; ESM 5734, Introduction to Finite Element Method; MATH 5425, Applied Partial Differential Equations; or MATH 5474, Finite Difference Methods for Partial Differential Equations. iii. Before taking the Final Examination, take two of the following courses: Courses in group (ii) not taken prior to the Preliminary Written Examination; AOE 5064, Structural Optimization; AOE 5314, Naval Ship

System Design and Effectiveness[3]; AOE 5374, Rationally-Based Design of Ocean Structures; AOE 5454, Advanced Aerospace and Ocean Engineering Instrumentation; AOE 6145, Computational Fluid Dynamics; AOE 6434, Computational Fluid Dynamics and Heat Transfer; or ESM 6314, Advanced Dynamics. Structures and Structural Dynamics i. Before taking the Preliminary Written Examination: AOE 4054, Stability of Structures or AOE 5054, Elastic Stability; AOE 4404, Applied Numerical Methods; AOE 5024, Vehicle Structures; AOE 5034, Mechanical and Structural Vibrations; AOE 5104, Advanced Aero and Hydrodynamics; and AOE 5204, Vehicle Dynamics and Control. ii. Before taking the Final Examination, any two of the following courses: AOE 5054, Elastic Stability; AOE 5064, Structural Optimization; AOE 5074, Advanced Ship Structural Analysis[4]; or AOE 6024, Aeroelasticity. Applied Physics & Space Engineering i. Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; One from ECE 5105, Electromagnetic Waves; ECE 5106, Electromagnetic Waves; PHYS 5405, Classical Electromagnetism; ECE 5104G, Microwave and RF Engineering; or AOE 5174, Introduction to Space Plasmas; One graduate level course in Mathematics, as determined by Advisory Committee; Three graduate level courses in AOE, Electrical and Computer Engineering, Physics, and/or Mechanical Engineering as described by the Advisory Committee; ii. Before taking the Final Examination: Any two from AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; or AOE 5204, Vehicle Dynamics and Control; and Courses determined in consultation with the Advisory Committee. Applied Mathematics i. Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; Two from AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; or AOE 5204, Vehicle Dynamics and Control; Four additional graduate level Math courses determined in consultation with the Advisory Committee. ii. Before taking the Final Examination: Courses determined in consultation with the Advisory Committee. 9. If a graduate student has previously taken, while an undergraduate or a student elsewhere, any of the required courses listed above or equivalent, that course must be replaced with another 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. 10. Students are required to repeat any courses on the Plan of Study for which a grade of "C-" or below has been earned. Transfer credits must have been earned while in good standing in graduate status, must have been graduate courses (numbered 5000 or higher, or equivalent) at the institution where the courses were taken, and must show a grade of "B" or better. Courses that are double-counted for both an undergraduate and graduate degree for students in Virginia Tech's Undergraduate/Graduate Degree Program are subject to the grade requirements for transfer courses. 11. A person who graduates from this department with a Ph.D. in aerospace engineering is expected to have a broad understanding of the field. The student satisfies this requirement by completing each of the introductory graduate courses in aerodynamics (AOE 5104), dynamics and control (AOE 5204 or AOE 5334), structures (AOE 5024 or AOE 5074), and numerical methods (AOE 4404) with a grade of B or better. That grade will be considered sufficient evidence of knowledge in these areas. Transfer credits for these courses are approved by including them in a properly formulated Plan of Study approved by the student's Advisory committee. For students in the "Applied Physics & Space Engineering" or "Applied Mathematics" track, these requirements apply to the courses above which appear on the Plan of Study. 12. If a student obtains less than a B in the introductory courses listed in Item 3 above, then that student must repeat the course, either formally (grade less than C-) or informally (grade equal or greater than C- and less than a B) and receive a grade of B or better in the course. In the case of an informal retake, the instructor will write a letter to the students file indicating the achievement of a grade of B or better. If this requirement is not completed at the time of the preliminary examination, and the student passes the preliminary examination, the student will be given a conditional pass. Under these circumstances, this requirement must be satisfied within two semesters (i.e. at the first opportunity) after completing the preliminary examination. [1] It is strongly recommended that students who wish to take AOE 6744: Linear Control Theory, first take AOE 5744: Linear Systems Theory or an equivalent course on linear, time-varying systems. [2] If AOE 4274: Computer-Based Design of Ocean Structures has already been taken, then one of the following two courses must be substituted: AOE 5024: Vehicle Structures or AOE 5374: Rationally-Based Design of Ocean Structures. [3] It is strongly recommended that students who wish to take AOE 5314: Naval Ship System Design and Effectiveness, first take AOE 4264: Principles of Naval Engineering. [4] If AOE 4274: Computer-Based Design of Ocean Structures has already been taken, then one of the following two courses must be substituted: AOE 5024: Vehicle Structures or AOE 5374: Rationally-Based Design of Ocean Structures.

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): AOE 5024

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. I

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:

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. 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):

AOE 5074:

Advanced Ship Structural Analysis

Computer modeling of ship structures. Levels and types of structural failures in ships. Elastic and inelastic plate bending. Elastic and inelastic buckling of columns, plates and stiffened panels. Computer programs for ultimate strength analysis of ships. Sample applications. 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): AOE 5024

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.

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)

Corequisite(s):

AOE 5135 (ME 5135):

Vehicle Propulsion

Aerothermodynamics of gas turbines and rockets: cycle analysis of turbojets, turbofans, prop fans, and turbo props. Analysis of ramjets and scramjets. Performance of inlets, combustors, and nozzles. Elementary theory of turbomachinery. Liquid and solid propellant chemical rockets. Electrostatic, electromagnetic, and electrothermal propulsion. Integrated rocket-ramjet. Fuels and propulsion systems for future transportation system.

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), ME 3134 (UG)

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, muliti-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 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 resistivtiy, 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 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 3134 (UG), AOE 3234 (UG) OR AOE 4140 (UG)

Corequisite(s):

AOE 5234:

Orbital Mechanics

Lagrange's equations of motion, two-body problem, conic sections, Kepler's laws, orbit determination. Multi-body problems and integrals of motion. Fundamentals of perturbation theory, variation of parameters, and Lagrange's 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): AOE 4134 (UG)

Corequisite(s):

AOE 5244:

Optimization Techniques

Ordinary minimum problems with constraints. The classical multiplier method, descent methods, and quasi-Newton methods. Optimal control and the maximum principle. Second-order necessary conditions. Singular control. Continuous gradient methods, conjugate gradients.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): AOE 3134 (UG), MATH 4564 (UG)

Corequisite(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 5305:

Marine Engineering

In depth analysis and design of major ship propulsion system and machinery components. 5305: Propellers, shafting and gearing. Intro. to boilers, steam and gas turbines, nuclear power plants and diesels. 5306: Advanced study of diesels and gas turbines. Internal combustion engines. Shipboard HVAC, pump and motor systems. Cost estimation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 3134 (UG)

Corequisite(s):

AOE 5314:

Naval Ship System Design and Effectiveness

Concepts, theory, and methods for the engineering, design, integration, and assessment of naval ship systems. Modeling of system effectiveness for multidisciplinary and multi-objective design optimization. Mathematical theory for naval effectiveness models (OEMs) and physics-based mechanical, electrical, sensor, control, and weapon systems models to assess total-ship effectivesness in anti-air warfare, target coverage, and fleet air warfare. System integration, interfaces, and analyses considering ship arrangements, electromagnetic compatibility, signatures, system deactivation diagrams, reliabiltiy, maintenance, modularity, system power, shock and weapons effects, fire analysis, damage control, and overal system survivability.

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 5405

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 5305, 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 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 3234 (UG), MATH 4564 (UG)

Corequisite(s):

AOE 5374:

Rationally-Based Design of Ocean Structures

Methodology of rationally-based optimum structural design of ships based on explicit calculation of failure loads. Torsion of thin-wall sections. Ultimate limit states of stiffened cylinders. Structural optimization of stiffened panels. Computer programs for ultimate strength analysis and structural design of ships, submarines and offshore platforms. Sample applications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 5074 (UG)

Corequisite(s):

AOE 5434G:

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:

Adv Dyn of High-Speed 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 5454:

Advanced Aerospace and Ocean Engineering Instrumentation

An advanced treatment of the principles of measurement systems; standards, accuracy, uncertainty and statistical concepts, and signal processing. Detectors, transducers, and instruments for aerospace and ocean engineering. Hot-wire and laser anemometry. Signal conditioning systems and readout devices, digital data acquisition principles. Electronics and electrical test instruments. Case studies of practical instrumentation systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): AOE 3014 (UG), AOE 3034 (UG)

Corequisite(s):

AOE 5464:

Combustion Chem & Diag

Combustion chemistry and laser-based combustion diagnostics from a fundamental, microscopic level. Statistical thermodynamics, molecular collisional models, chemical kinetics, reaction mechanisms for combustion systems, spectroscopy (absorption, Rayleigh, Raman, and Laser Induced Fluorescence), and diagnostics for measuring various combustion properties. Practical implementation and industrial 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):

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 macroscal 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 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
Instruction Type(s): 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
Instruction Type(s): 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 (ECE 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 (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 pratical 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 (ECE 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.
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 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

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

AOE 5904:

Project and Report

NONE

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 5914 (ECE 5914) (ME 5914):

Autonomous Systems Seminar

Weekly technical presentations from local and visiting scholars on current topics related to the theory, design and development, and application of autonomous vehicle systems. Pre-Requisite: Graduate Standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

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 Master's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

AOE 5974:

Independent Study

NONE

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

NONE

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

NONE

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 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.

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 5104

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

Instruction Type(s): 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 turbulance, 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 designer's perspective. Structure of the control-oriented equations of motion in relation to robust control design. Bio-inspiried design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): AOE 5024, AOE 5204

Corequisite(s):

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 commerical CFD packages to select problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 uncertainy through models. Estimation of total prediction uncertainy 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 (ECE 6744) (ME 6544):

Linear Control Theory

Advanced introduction to the theory of optimal control of time-varying and time-invarient 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) (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

Instruction Type(s): Lecture

Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)

Corequisite(s):

AOE 6974:

Independent Study

NONE

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

NONE

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

NONE

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

Mary Leigh Wolfe, Head

Emeriti Faculty: John Cundiff;

Professors: Brian Benham; Robert Grisso; William Hession; Saied Mostaghimi; Mary Leigh Wolfe; Chenming Zhang;

Associate Professors: Justin Barone; Zachary Easton; Conrad Heatwole; Leigh Anne Krometis; Jactone Ogejo; David Sample; Durelle Scott; Ryan Senger; Theresa Thompson;

Assistant Professors: Jonathan Czuba; Julie Shortridge; Venkataramana Sridhar;

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

General Contact: bseacademics@vt.edu

Graduate Site: http://www.bse.vt.edu/graduate/index.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

B-incubator Laboratory Biomolecular Engineering Laboratory Bionanotechnology Laboratory Bioseparation Laboratory BSE Pilot Laboratory Byproduct Management Laboratory Center for Watershed Studies Ecological Engineering Laboratory Environmental Processes Laboratory Fluvial Processes Laboratory Food Processes Laboratory Hydroecology Laboratory Metabolic Engineering and Renewable Materials Laboratory Mycotoxin Analysis Laboratory Prices Fork Research Facility Sediment Laboratory StREAM Lab Synthetic Enzyme and Pathway Engineering Laboratory Water Microbiology Laboratory Water Quality Laboratory Watershed Assessment Laboratory Watershed Monitoring Laboratory

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

Master of Science - Thesis (MS)The Department offers the MS degree with a thesis option. For a thesis option, 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.Master of Science - Non-thesis (MS)The Department offers the MS degree, non-thesis option as well. For a non-thesis option, the student will be involved in completing a focused research/design activity and submit a research report and make an oral presentation detailing the research findings. A minimum of 30 total credits (24 course credits) are required.

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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: (80.0)

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 (BMES 5044) (CHE 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BSE 5214:

Advanced Topics in Watershed Management

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BSE 5224G:

Advanced Field Methods in Hydrology

Site characterization: surveying, channel and floodplan mapping, land use, electronic data acquistion. Techniques for measuring surface and subsurface hydrological processes: water flow, hydrologic conductivity, precipitation, evaporation. Sampling techniques: suface 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

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

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 evelation 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

Instruction Type(s): Lab, Lecture

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

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

BSE 5354:

Nonpoint Source Pollution Modeling

Examination of the fundamental structure of nonpoint source pollution models, considering components, parameters and dependent variables, governing mathematical relationships; spatial variation of inputs; upland sediment and nutrient transport; and nonpoint source pollution control planning. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): BSE 5304 (UG) OR BSE 5304 (UG)

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. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

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 5504G:

Adv. Bioprocess Engineering

Study of engineering concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals. Emphasis is placed on enzyme kinetics and technology, bioreaction kinetics, design, analysis, and control of bioreactors and fermenters, and downstream processing of bioreaction products. 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 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 5624:

Enzyme Engineering

Latest advances in industrial applications of enzymes, kinetic models on solid substrates, protein engineering tools (rational design and directed evolution), and cell-free synthetic enzymatic pathway biotransformations for the production of biofuels and bioelectricity. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BSE 5644:

Biobased Ind Polymers

Importance of biological feedstocks (i.e., proteins, polysaccharides, and fats) to industrial polymers and the future economy. Chemistry and processing of biological feedstocks into polymers. Properties of biobased polymers. Pre-requisites: Graduate Standing and Knowledge of thermodynamics, transport phenomena, and organic chemistry required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BSE 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BSE 5904:

Project and Report

NONE

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BSE 5974:

Independent Study

NONE

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):

BSE 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BSE 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CHEMICAL ENGINEERING

David Cox, Head

Professors: Luke Achenie; Donald Baird; David Cox; Richey Davis; William Ducker; Erdogan Kiran; Yih-An Liu; Chang Lu; Padmavathy Rajagopalan;

Associate Professors: Aaron Goldstein; Ayman Karim; Stephen Martin; Abby Whittington;

Assistant Professors: Michael Bortner; Sanket Deshmukh; Rong Tong; Hongliang Xin;

Alexander F. Giacco Professor: Donald Baird;

Frank C. Vilbrandt Professor: Yih-An Liu;

Robert E. Hord, Jr. Professor: Padmavathy Rajagopalan;

Fred W. Bull Professor: Chang Lu;

Graduate Coordinator: dianec@vt.edu

Graduate Chair: wducker@vt.edu

Department Head: dfcox@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, environment, and food. 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 as well as the usual emphasis upon analysis. There is a strong thread of physics, chemistry, mathematics, biochemistry, and microbiology in much of the research in the department. Active research areas include polymer chemistry, polymer science and engineering, colloid and surface chemistry, solid state chemistry and physics, nanotechnology, applied thermodynamics, molecular modeling, biochemical and tissue engineering, biomaterials, nanomedicine, catalysis and surface science, design for sustainability, green engineering, 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 14 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

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. Specific examples include nanoparticles of block polymers that bind drugs and superparamagnetic iron oxide particles for imaging biodistribution, nanoparticles consisting of polysaccharides and drugs for oral drug delivery, and metal nanoparticles with tailored optical properties for applications in chemical sensing and imaging applications. The lab is equipped with instrumentation to characterize the size distributions, surface chemistry, compositions, and related properties of nanoparticles.

Catalysis, Nanomaterials and In Situ/Operando Characterization Lab

Our research is multidisciplinary in the areas of nanomaterials synthesis, in situ/operando characterization, and heterogeneous catalysis. In the nanomaterials synthesis area, work is directed at understanding the nucleation and growth mechanisms of colloidal nanoparticles with the aim to control their size, shape and composition. In the heterogeneous catalysis area, the work is focused on designing catalysts with molecularly tailored properties for biomass conversion, shale gas utilization and automotive exhaust emission applications. The use of microreactors and advanced in situ/operando characterization tools is the cornerstone of the research program and includes: spectroscopy (X-ray absorption and infrared), small angle X-ray scattering, transmission electron microscopy and others.

Colloidal and Surface Engineering Laboratory

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.

Computational Catalysis Lab

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

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

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

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 separation in bioprocessing and chemical engineering, polymer process modeling and advanced process control, etc.

Laboratory for Biomaterials and Tissue Engineering

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

Research focuses on the synthesis, characterization and applications of soft and nanostructured materials, including surfactants, thin films, liquid crystals, liquid crystal polymers, block copolymers and nanocomposites. Particular emphasis is placed on the relationships between structure in soft materials, materials processing, and control of material properties. Applications include membranes for gas, liquid, and chiral separations; functional and responsive surfaces; and polymer and nanocomposite processing. Specialized instrumentation in the lab includes equipment for X-ray Scattering (SAXS and WAXD), optical microscopy, spin coating, contact angle goniometry, liquid chromatography, gas chromatography, isothermal adsorption gravimetry, and gas and liquid permeation (single gas, mixed gas, membrane chromatography, and reverse osmosis.)

Microfluidics Lab

Development of microfluidic devices for studying cells and biomolecules. Research also focuses on understanding microscale fluid mechanics.

Multiscale and Multiphysics Modeling Lab

This facility specializes in molecular to macro-scale modeling and scientific computing. There are applications to chemical/reactive processes and biomedical problems of current interest. The facility has a medium size Beowulf style high computing environment.

Polymer Rheology and Processing Lab

This laboratory is equipped with devices for measuring the basic flow properties of polymeric fluids and their composites and small scale processing facilities for converting the fluids into useful materials. The basic flow properties are used in the design of processes for converting these fluids into materials with optimum performance and properties. Computing facilities are available for numerical simulation of polymer processing operations.

Polymer and Composites Materials Laboratory

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 (450°C), multi-material FDM; modulated DSC; FTIR + MCT, ATR; laboratory scale injection molding, 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

Research in this lab concerns the fabrication of biocompatible polymer scaffolds for the regeneration of bone, cartilage, 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 stem cell viability and expression of skeletal tissue phenotypes.

Supercritical Fluids and High Pressure Lab

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 200 oC. 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 are among the active research areas.

Ultrahigh Vacuum Surface Science Lab

Capabilities for chemical and structural characterization of solid surfaces and surface reactivity using photoemission, electron diffraction, and temperature programmed desorption experiments.

DEGREES OFFERED

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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 (MSE 5014) (CHEM 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHE 5034:

Introduction to Polymer Materials

Homopolymerization, copolymerization, polymer, architecture, morphology, thermal transitons, 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

Instruction Type(s): 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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CHE 3184 (UG) OR 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CHE 2164 (UG) OR CHE 2164

Corequisite(s):

CHE 5214 (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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): 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 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

Instruction Type(s): Lecture

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

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

Instruction Type(s): Lecture

Prerequisite(s): CHE 3114 (UG) OR CHE 3114

Corequisite(s):

CHE 5904:

Project and Report

NONE

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 student's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHE 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CHE 5994:

Research and Thesis

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CIVIL ENGINEERING

William Easterling, Head

Emeriti Faculty: Gregory Boardman; William Cox; J Duncan; James Mitchell; Thomas Murray; John Novak; Clifford Randall; Kamal Rojiani;

Professors: Thomas Brandon; Finley Charney; Andrea Dietrich; Gerardo Flintsch; Daniel Gallagher; Russell Green; Zhen He; Jennifer Irish; William Knocke; Roberto Leon; John Little; Amy Pruden-Bagchi; Hesham Rakha; Carin Roberts-Wollmann; Adrian Rodriguez-Marek; Sunil Sinha; Antonio Trani; Linbing Wang; Mark Widdowson; Jesus de la Garza;

Associate Professors: Deborah Dickerson; Matthew Eatherton; Michael Garvin; Kevin Heaslip; Erich Hester; Matthew Mauldon; Kyle Strom;

Assistant Professors: Madeleine Flint; Matthew Hebdon; Susan Hotle; Eric Jacques; Farrokh Jazizadeh Karimi; Frederick Paige; Earl Shealy; Denise Simmons; Nina Stark; Zhiwu Wang; Alba Yerro Colom;

Vecellio Professor: Jesus de la Garza;

Associate Professor of Practice: Joseph Dove;

Research Associate Professors: Adil Godrej;

W. Curtis English Professor: William Knocke;

W. Thomas Rice Professor: Amy Pruden-Bagchi;

Samuel Reynolds Pritchard Professor: Hesham Rakha;

David H. Burrows Professor: Roberto Leon;

Assistant Professor of Practice: Robert Scardina; Kevin Young;

Charles E. Via, Jr. Professor: John Little;

Graduate Contact: shmartin@vt.edu

Extended Campus Contact: shmartin@vt.edu

Student Handbook: https://www.cee.vt.edu/wp-content/uploads/2017/07/Graduate-Policies-and-Procedures-Manual-

Departmental.pdf

Graduate Site: https://www.cee.vt.edu/prospective-graduate-students/

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, hydrosystems 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 at achieving these goals and in offering attractive graduate study opportunities can be measured by the fact that graduate programs have grown substantially over the past 15 years, while student qualifications have also improved. Today, the graduating classes typically include approximately 120 MS degrees, and 24 Ph.D. degrees. The graduate enrollment of approximately 320-360 on the main campus and another 40-50 students at extended campuses make this program one of the largest in the Southeast. The department routinely ranks in the top 10 civil engineering programs in the United States. Likewise, certain graduate program areas are ranked among the best available in the U.S. The department has 59 full-time and ten active emeritus faculty members, of which three 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. Fourteen 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 40 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. Through a combination of full- and part-time resident faculty, the department offers several graduate program emphasis areas (civil infrastructure engineering, construction engineering and management, environmental engineering and sciences, and advanced transportation systems) through the University's Northern Virginia Center in Falls Church. In addition, the department offers graduate degree opportunities in civil infrastructure engineering and environmental engineering via the Virginia Cooperative Graduate Education Program, a distance learning program that provides engineering courses throughout the Commonwealth by live transmission of courses.

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.

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 Tranportation 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 (Virtual, Blacksburg, National Capital Region)

TOEFL

Paper: (570.0)

iBT: (88.0)

GRE

General Test: Verbal, Quantitative, Analytical

Please NOTE that VIRTUAL course offerings are limited. Some program areas can provide a full MS program for virtual campus students, but other program areas only offer some courses. Please see information about our graduate certificate programs in the certificate section of the Graduate Catalog. See Departmental Manual at http://www.cee.vt.edu/wp-content/uploads/2016/08/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

Degree Concentrations:

Program Area Concentrations

Construction Engineering and Management Environmental and Water Resources Engineering Geotechnical Engineering Structural Engineering and Materials Transportation Infrastructure and Systems Engineering

Interdiscplinary Program Area Concentrations

Civil Infrastructure Engineering Geospatial Engineering

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (570.0)

iBT: (88.0)

GRE

General Test: Verbal, Quantitative, Analytical

See Departmental Manual at http://www.cee.vt.edu/wp-content/uploads/2016/08/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (570.0)

iBT: (88.0)

GRE

General Test: Verbal, Quantitative, Analytical

See Departmental Manual at http://www.cee.vt.edu/wp-content/uploads/2016/08/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

Degree Concentrations:

Program Area Concentrations

Construction Engineering and Management Environmental and Water Resources Engineering Geotechnical Engineering Structural Engineering and Materials Transportation Infrastructure and Systems Engineering

GRADUATE COURSES (CEE)

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): null null

Corequisite(s):

CEE 5014:

Facility Delivery & Financing

Delivery and financing of constructed facilities with an emphasis uopn 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 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 reducting costs and easing the burden of dispute resolution. Techniques for quantifying and resolving claims are studied. 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):

CEE 5074:

Global Virtual Design and Construction

Fundamental aspects of modern civil engineering project execution in vitual workspaces. Participation in team-based vitrual 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/cutures. Both theory and practice emphasized. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CEE 5080:

Infrastructure Asset Mgt

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 techology, database and data analysis software applciations 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): null null

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

Instruction Type(s): 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): null null

Corequisite(s):

CEE 5124:

Fundamentals of Environmental Toxicology

Introduction to nomenclature, principles, and scope of environmental toxicology. The fate and effects of both organic and inorganic toxicants in the environment, in animals, and in various test systems. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CEE 5104 (UG) OR CEE 5104

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): null null

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 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): null null

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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): (CEE 5125 (UG) OR CEE 5126 (UG)) OR (CEE 5125 OR CEE 5126)

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

Instruction Type(s): 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 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

Instruction Type(s): 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): 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):

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. 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):

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.

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:

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

Instruction Type(s): Lab, Lecture

Prerequisite(s): null null

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 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 be drawn from environmental and water resources topics. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5324:

Advanced Hydrology

Applications of statistics to hydrology, floods, and droughts; flow generation models; mathematical models in physical hydrology; difference methods in flow routing; kinematic wave; evapo-transpiration; infiltration; and atmospheric processes. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5354 (GEOS 5814):

Numerical Modeling of Groundwater

Thoery 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 BC's and IC's. 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5364:

Water Law

Analysis of law for allocation of surface and groundwater supplies, legal controls over water quality alteration, public rights of water use, and drainage law. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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): null null

Corequisite(s):

CEE 5384:

Transport Processes in Waterways

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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 standars. Pre: Graduate Standing.

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CEE 5424:

Computer Analysis of Structures II

Extension of matrix displacement method to skeletal space structures: space trusses, space frames, and grids. Incorporation of special features such as nonglobal constraints, assemblies of different types of elements, thermal problems, substructuring, and buckling analysis. Development of well-structured programs on the mainframe and transfer to the personal computer. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5424G:

Intermediate Design of Prestressed Concrete Structures

Principle of prestressing applied to concrete beams, slabs, and frames; design of individual elements and structural systems of presressed concrete; precast construction and connection design. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CEE 5434:

Design of Cold-formed Steel Structures

Behavior and design of cold-formed steel members. Strength of thin plate elements; flexural members; compression members, symmetric and non-symmetric; beam-columns; welded, bolted, and screw-fastened connections. Building systems that utilize cold-formed steel members. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5444:

Stability of Structures

Methods of static structural stablity 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5474G:

Intermediate Reinforced Concrete Structures

Behavior and design of continuous reinforced concrete structures subjected to gravity and lateral loads. Application of computer programs to frame analysis and design of members. Development length, biaxial bending of columns, continuous one-way beams and slabs, two-way floor systems, torsion, footing, and cantilever retaining wall design problems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5504:

Risk Analysis Geotechnical Engineering

Methods for risk analysis of complex systems. Basic concepts of probabliity and reliability applied to geotechincal 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

Instruction Type(s): Lecture

Prerequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CEE 5514 (UG) OR CEE 5514

Corequisite(s):

CEE 5574:

Environmental Geotechnics

Geotechnical aspects of environmental engineering projects. Fundamentals of soil behavior, site characterization, and contaminant transport; methods for geotechnical engineering practice for waste disposal, waste containment, and site remediation; waste landfills. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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 attirbute 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): 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): null null

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 5620:

Transportation Network Analysis

Optimal paths in transportation networks, transportation network design, vehicle routing and scheduling, facility location problems, traffic flows on networks, traffic assignment 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):

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): null null

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): null null

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): null null
Corequisite(s):

CEE 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. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
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): null null
Corequisite(s):

CEE 5660:

Trans Risk, Reliab & Security

Transportation risk assessment and computation; evacuation modeling; reliability analysis; infrastructure interdependency analysis; network impact 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): null null
Corequisite(s):

CEE 5674:

Advanced Pavement Design

Methods used to characterize, stabilize, and specify pavement materials. Methods for rigid and flexible highway and airport pavement design and analysis. Load equivalence factor and specific design considerations related to environment and traffic characteristics. Pavement overlay design. Software for pavement design and analysis using various models. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
Corequisite(s):

CEE 5684:

Rehabilitation of Transportation Structures

Identification of maintenance and rehabilitation needs for transportation structures such as bridges and pavements. Cost effective maintenance and rehabilitation methods. Consideration of bridge and pavement management systems. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
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 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): 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):

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5774:

Hazardous Waste Management

Review of regulatory framework governing hazardous waste management. Characteristics of hazardous wastes. Fundamental physical, chemical, and biological principles applied to the design of treatment processes. Risk management. Case studies. Design project. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s): CEE 5104

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): 0 OR 3

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): null null

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): null null

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 liquefication as a consequence of cyclic loadings adn 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:

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 Estuarine Morphodyn

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 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CEE 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CEE 5944:

Seminar

Review and discussion of current literature, research, and consulting activities by student, faculty, and guest speakers. I,II

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

NONE

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):

CEE 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CEE 5154

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 6504:

Theoretical Soil Mechanics

Constitutive Laws for Soils, nonlinear elastic and plastic models. Consolidation, layered systems, sand drains, approximate three-dimensional theories, and Biot's poro-elastic formulation. Plastic equilibrium in soils Sokolovski's 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture
Prerequisite(s): CEE 5514 (UG) OR CEE 5514
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
NONE
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
NONE
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 ENGINEERING

Luke Lester, Head

Emeriti Faculty: Robert Broadwater; Gary Brown; William Davis; Douglas Lindner; Arun Phadke; Krishnan Ramu; Warren Stutzman; James Thorp;

Professors: Masoud Agah; Paul Ampadu; Peter Athanas; Scott Bailey; Aloysius Beex; Dushan Boroyevich; Richard Buehrer; Thomas Clancy; C Clauer; Gregory Earle; Dong Ha; Yiwei Hou; Michael Hsiao; Mark Jones; Jih Lai; Fred Lee; Luke Lester; Chen-Ching Liu; Thomas Martin; Theresa Mayer; Scott Midkiff; Lamine Mili; Khai Ngo; Mariusz Orlowski; Jung-Min Park; Paul Plassmann; Ting Chung Poon; Saifur Rahman; Sanjay Raman; Binoy Ravindran; Jeffrey Reed; Ahmad Safaai-Jazi; Timothy Sands; Wayne Scales; Patrick Schaumont; Daniel Stilwell; Joseph Tront; Yue Wang; Anbo Wang; Yong Xu; Jianhua Xuan;

Associate Professors: Amos Abbott; Joseph Baker; William Baumann; Rolando Burgos; Virgilio Centeno; Jaime De La Reelopez; Steven Ellingson; Louis Guido; Mantu Hudait; Lingjia Liu; Allen MacKenzie; Leyla Nazhandali; Willem Odendaal; Cameron Patterson; JoAnn Paul; John Ruohoniemi; Walid Saad; Chris Wyatt; Yaling Yang;

Assistant Professors: Thidapat Chantem; Harpreet Singh Dhillon; Ryan Gerdes; Mona Ghassemi; Jia-Bin Huang; Xiaoting Jia; Vasileios Kekatos; Kwang-Jin Koh; Qiang Li; Elena Lind; Majid Manteghi; Chang Woo Min; Pratap Tokekar; Ryan Williams; Yang Yi; Guoqiang Yu; Haibo Zeng; Wei Zhou; Yizheng Zhu;

Grant A. Dove Professor: Yue Wang;

Hugh P and Ethel C Kelly Professor: James Thorp;

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;

L-3 Communications Cyber Faculty Fellow: Thomas Clancy;

Roanoke Electric Steel Professorship in Engineering: Luke Lester;

American Electric Power: Chen-Ching Liu;

Graduate Admissions: vt.ece.gradadm@vt.edu

Graduate Counseling: eceadvising@vt.edu

NCR Graduate Coordinator: roxpaul@vt.edu

Student Handbook: http://www.ece.vt.edu/gradman/manual.php

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. All 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). For the master's degree, each plan of study, developed by the student in consultation with his or her faculty advisor, must contain a limited number of core courses. The M.S. degree program requires a thesis. The M.Eng. is a non-thesis degree program and is especially suitable for part-time graduate students employed as engineers by industry and government agencies.The Ph.D. degree program is research-oriented. Applicants applying for these degrees program must have an earned Master's degree in CPE, EE or related field. A direct-Ph.D. option is available for students without an earned Master's degree. These students will earn a Master of Science, Thesis, or Master of Science, Non-Thesis, degree in addition to the Ph.D. The Bradley Department of Electrical and Computer Engineering's current enrollment is approximately 535 students. Out of the enrolled students, approximately 95% of our full-time Ph.D. students are funded and approximately 75% of our full-time Master's student are funded.Funding is available in three ways: Graduate Teaching Assistantships - Awarded by the department Graduate Research Assistantships - Awarded by individual faculty Fellowships - Awarded by the department to the top applicants to the program. Of the fellowships awarded by the department, the Bradley 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: (96.0)

GRE

General Test: Verbal (153.0), Quantitative (157.0), Writing (4.5)

IELTS

General: Band (7.5)

32 credit hours 27 credit hours of course work 3 credit hours of project and report 2 credit hours of seminar 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)

32 credit hours 21 credit hours of course work 9 credit hours of research and thesis 2 credit hours of seminar 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 PhD Requirements (for students with an earned Masters):92 credit hours 30 credit hours of course work 60 credit hours of research and thesis 2 credit hours of seminar Direct-PhD Requirements (for students with only an earned Bachelors):MS, Thesis and PhD - 92 credit hours 21 credit hours of coursework for MS (all transfer to PhD) 9 additional credit hours of coursework for PhD 9 hours of research and thesis for MS 60 credit hours of research and dissertation for PhD 2 credit of seminar that will count for both MS and PhD MS, Non-Thesis and PhD - 92 credit hours 30 credit hours of coursework for MS (all transfer to PhD) 60 credit hours of research and dissertation for PhD 2 credit of seminar that will count for both MS and PhD The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

GRADUATE COURSES (ECE)

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 amplifer design. Microwave Integrated Circuits (MIC). RF Microelectromechincal System (MEMS) components. Microwave systems. RF components for wireless systems. RF components for Ultra Wide band (UWB) systems. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECE 5105:

Electromagnetic Waves

5105: Fundamentals of pane wave propagation, reflection, and transmission; basic theorems, equivalent currents, and Green's 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): null null

Corequisite(s):

ECE 5106:

Electromagnetic Waves

5105: Fundamentals of plane wave propogation, reflection, and transmission; basic theorems, equivalent currents, and Green's 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): (ECE 3106 (UG), ECE 3614 (UG)) OR (ECE 3106, ECE 3614)

Corequisite(s):

ECE 5164:

Introduction to Space Science I: The Solar Wind and Magnetosphere

Describes the space environment from the sun to the earth's 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 resistivtiy, 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 Earth's environment and their implementation in engineering systems; societal applications of remote sensing; fundamental principles of electromagnetic wave propogation 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 distribtutions; 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
Instruction Type(s): 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
Instruction Type(s): 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. 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):

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
Instruction Type(s): 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 5220:

Radio Frequency Integrated Circuit Technology and Design

Integrated circuit (IC) implementation of RF circuits for wireless communications applications. Transceiver architectures for current wireless communications standards; active/pasive device technologies for RFIC implementations; low noise amplifiers; mixers; frequency sources; power amplifiers; single-chip radios; and RFIC packaging and testing. Case studies of modern RFIC chip sets for current wireless communications standards are examined. The course involves circuit design at the IC level; modern RF/microwave CAD software will be used in conjunction with the course. Design of a wireless transceiver functional block component RFIC chip. Alternate years. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): (ECE 3204 (UG), ECE 3614 (UG)), (ECE 4605 (UG) OR ECE 4104 (UG)) OR (ECE 3204, ECE 3614), (ECE 4605 OR ECE 4104)
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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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. II

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

Instruction Type(s): 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. II

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. I

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:

Electric Machines and Transients

Development of inductances, flux linkages, voltage equations, linear transformations, continuous simulation techniques, and machine models. Transients on transmission lines, transformers, and machines. Arcing and restriking phenomena. Lightning arresters and insulation coordination. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECE 4314 (UG) OR ECE 4314

Corequisite(s):

ECE 5374G:

Adv Alternate Energy Systems

Electric energy from alternative energy sources including solar, wind, hydro, biomass, geothermal and ocean. Chacteristics 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. 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 5424G:

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, strucutred 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. (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):

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 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. (3H,3C)
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 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 teh 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 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 Fault-tolerant Computing

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
Instruction Type(s): Lecture
Prerequisite(s): ECPE 4505
Corequisite(s):

ECE 5506:

Testing and Fault-tolerant Computing

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

Instruction Type(s): 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 5520:

Secure Hardware Design

Design and implementation of secure hardware at multiple levels of abstractions, covering cryptographic hardware primitives, cryptographic hardware primitives, cryptographic modules using passive attacks, active attacks, and cryptanalytic techniques. Countermeasures against reverse engineering. The course uses case studies and literature surveys to reflect on the state-of-the-art in secure hardware implementation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECE 4514 (UG) OR ECE 4514

Corequisite(s):

ECE 5530:

Configurable Computing

The design and implementation of high-performance computing machinery using configurable computing technology is studied. Contemporary computing methodologies are investigated, modeled, and constructed in laboratory exercises. Computational solutions are implemented by using field programmable gate arrays and adaptive computing devices.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (ECE 4514 (UG), ECE 5504 (UG)) OR (ECE 4514, ECE 5504)

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 profiiciency in programming and modeling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECE 4514 (UG) OR ECE 4514

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

Instruction Type(s): 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 prograaming 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

Instruction Type(s): 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): null null

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

Instruction Type(s): 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 5566):

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 5574G:
ADV Software Development CAE
Computer-aided engineering software that address the hierarchy of engineering analysis, design, and decision evaluation is developed with state-of-the-art computer tools. Linear graph theory is applied to the modeling of physical networks. Operator overloading, dynamic polymorphism, graphical user interfaces, dynamic link libraries, and multiple threaded programs are considered. Pre-requisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ECE 5575:
Object-Oriented Software Devel
Use cases, class models, state models, interaction modeling, constraint modeling, message design, and concurrent and real-time systems. Students develop analysis documentation for an Engineering related project.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4574 (UG) OR ECE 4574
Corequisite(s):

ECE 5576:
Object-Oriented Software Devel
Object-oriented design, including both logical and physical design. In logical design, rules related to class interfaces, containment, inheritance, and associations are covered along with design patterns. Physical design addresses components, levelized designs, and the application of generic programming concepts in design. Students develop design documentation for an engineering software project.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): ECE 4574 (UG) OR ECE 4574
Corequisite(s):

ECE 5580 (CS 5580):
Cryptopgraphic 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.
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 5585:
IT Security and Trust
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 techiniques. 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 5586:
IT Security and Trust
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.
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 5604:
Computer-Aided Design and Analysis of Communication Systems
Simulation techniques for communication systems operating in random environments. Simulation models for stochastic signals and system components including coders, decoders, modulators, non-linear amplifiers, bit and carrier synchronizers, equalizers and receivers. Techniques for modeling time-varying channels. Monte Carlo simulation, semi-analytic simulation and variance reduction techniques applied to the analysis, design and performance evaluation of communication systems. Programming experience required.
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), STAT 4714 (UG)) OR (ECE 4624, ECE 4634, STAT 4714)
Corequisite(s): ECE 5605

ECE 5605 (BMES 5525):
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. I
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
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. II
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. I
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 velcoity, 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): null null
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 5665:

Telecommunications

5665: Basic concepts in electrical engineering. Waveforms, spectra bandwith. Fourier series and tansform. Decibels, SNR, BER. Analog and digital transmission and modulations. Wire and radio links, link budgets, SNR and BER. Pre: Graduate standing. 5666: Analog modulations, AM, FM. Digital Modulations, ASK, FSK, PSK, QAM. RRC filtering, digital transmissions. Multiplexing, multiple access. Error control, FEC, ARQ. Local area networks. Optical communication systems. Satelite communcations, GPS.

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 5666:

Telecommuncations

5665: Basic concepts in electrical engineering. Waveforms, spectra bandwith. Fourier series and transform. Decibels, SNR, BER. Analog and digital transmissions and modulations. Wire and radio links, link budgets, SNR and BER. Pre: Graduate standing 5666: Analog modulations, AM, FM. Digital Modulations, FSK, PSK, QAM. RRC filtering, digital transmission. Multiplexing, multiple access. Error control, FEC, ARQ. Local area networks. Optical communication systems. Satelite communications, GPS.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5665

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 5684:

Error Control Coding

Use of error control codes to improve the reliability of digital communication and storage systems in the presence of noise. Algebraic structure of codes over finite fields. Error detecting and correcting codes. Block codes and convolutional codes, including Reed Solomon codes, LDPC codes, and turbo codes. Pre: Graduate standing.

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 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 (CS 5584):

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

Instruction Type(s): 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 (AOE 5764) (ME 5564):

Applied Linear Control

Analysis and design of sampled-data systems, extracton 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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):

ECE 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECE 5904:

Project and Report

NONE

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 5914:

Autonomous Systems Seminar

Weekly technical presentations from local and visiting scholars on current topics related to the theory, design and development, and application of autonomous vehicle systems. Pre-requisite: Graduate Standing required

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

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. I,II

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECE 5974:

Independent Study

NONE

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):

ECE 5984:

Special Study

NONE

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

NONE

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

Instruction Type(s): Lecture

Prerequisite(s): ECE 5105

Corequisite(s):

ECE 6114:

Advanced Analytical Electromagnetics

This course comprises PhD-level material covering exact and asymptotic analytical techniques for the solution of advanced electromagnetic problems involving wave propagation and scattering by finite and extended media inhomogenieties.

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 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 confiurations, 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, Green's 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 tranmission 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

Instruction Type(s): Lecture

Prerequisite(s): ECE 5105

Corequisite(s):

ECE 6174 (AOE 6174):

Computational Plasma Dynamics

Computational techniques for intestigating 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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. 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):

ECE 6314:

Advanced Instrumentation in Power Systems

Role of advanced instrumention 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

Instruction Type(s): 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. II

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- maching 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 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):

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:

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 propogation), 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 5424G OR CS 5824
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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): ECE 5565 (UG) OR ECE 5565
Corequisite(s):

ECE 6570 (CS 6570):

Advanced Foundations of Networking

This course covers theoretical foundations that are necessary for advanced study of networking. It focuses on algorithm desidn and optimization techniques that are most commonly used to solve complex networking problems. Major topics include complexity analysis with applications to networking problems, design and proof of approximation algorithms, design of meta-heuristic algorithms, formulation techniques for network optimization, linear and non-linear optimization techniques with applications to networking, design of distributed algorithms with proof of convergence for networks systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): ECE 5565 (UG) OR CS 5565 (UG) OR ECE 5565 OR CS 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

Instruction Type(s): 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-invarient 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 (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

Instruction Type(s): Lecture

Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)

Corequisite(s):

ECE 6984:

Special Study

NONE

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

NONE

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; Hillyard Hartson; Barbara Ryder;

Professors: Osman Balci; Christopher Barrett; 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; Madhav Marathe; T Murali; Christopher North; Alexey Onufriev; Calvin Ribbens; Adrian Sandu; Clifford Shaffer; Deborah Tatar; Layne Watson;

Associate Professors: Godmar Back; Yang Cao; Denis Gracanin; Aisling Kelliher; Donald McCrickard; Eli Tilevich; Anil Vullikanti; Danfeng Yao; Liqing Zhang;

Assistant Professors: Matthew Hicks; Bert Huang; Xun Jian; Changhee Jung; Dongyoon Lee; Na Meng; Tanushree Mitra; Bodicherla Prakash; Sharath Raghvendra; Francisco Servant Cortes; Gang Wang;

Affiliated Faculty: Nicholas Polys;

Elizabeth and James E. Turner Jr. '56 Faculty Fellowship: Wu-Chun Feng;

Associate Professor of Practice: Steven Harrison;

Research Scientists: Andrea Kavanaugh;

J. Byron Maupin Professor: Barbara Ryder;

General Contact: gradprog@cs.vt.edu

Graduate Site: http://www.cs.vt.edu/graduate

Student Handbook: https://www.cs.vt.edu/graduate/handbook

The graduate program at the Department of Computer Science at Virginia Tech is poised to become one of the top programs in the country. Currently ranked at #40 in the US News and World Report 2014 scores for graduate CS programs, additional accolades include being an NSF-identified top-30 program in the US (by number of Ph.D. degrees awarded) and as the #5 CS program in the country preferred by IT recruiters, according to a Wall Street Journal survey in 2010.

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.

Bioinfomatics 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 tripple nVidia GTX680 cards.

Center for High-End Computing Systems (CHECS)

System G: The System G cluster consists of 324 Mac Pros, each with two 4-core 2.8 GHz Intel Xeon processors (for a total of 2592 processor cores) and eight GB of RAM. The system is the first supercomputer running over quad data rate (QDR) InfiniBand (40Gbs) interconnect technology. System G (for "green") also has unique power- aware capabilities, with thousands of power and thermal sensors allowing CHECS researchers to design and develop algorithms and systems software that achieve high-performance with modest power requirements, and to test such systems at unprecedented scale. System G has a sustained (Linpack) performance of 22.8 TFlops.Imola cluster: This cluster, built by the PEARL (Parallel Emerging Architectures Research Lab), features four 8-way nodes with dual-core AMD Opteron Socket-F processors running at 2.4 GHz. Each node is organized in a NUMA topology with 8 dual-core processor sub-nodes, 2 GB of memory per processor sub-node and a HyperTransport interconnect. The nodes are connected with GigE. The cluster features customized OS modules for power management and memory management to achieve maximum efficiency in scientific HPC workloads. PlayStation3 cluster: Students and faculty from the SCAPE (Scalable Performance Laboratory), PEARL and SyNeRG (Systems, Networking, and Renaissance Grokking) Lab have built a 24-node cluster out of PS3s.ICE cluster: The SyNeRG lab has a 9-node (36-core) ICE cluster, made up of dual-core, dualprocessor AMD Opteron 2218 CPUs and used primarily for research in power-aware computing and high-performance networking.System X: CHECS works closely with Virginia Tech's Advanced Research Computing facility (VT-ARC). The most powerful system available through VTARC is System X, an 1100 node (2200 processor) cluster, which was designed and built under the leadership of CHECS faculty members. Each System X node is a dual processor (64 bit, 2.3 GHz IBM PPC970) Apple G5 Xserve with 4 GB of memory and a 80GB disk, for an aggregate 4.4 terabytes of main memory and 88 terabytes of temporary storage. In addition, a 53 terabyte network-attached storage facility is available to System X users. The nodes of System X are interconnected over two communication fabrics: an Infiniband switching fabric and a Gigabit Ethernet fabric. The 2304 port Infiniband fabric provides 20 Gbps bandwidth per node with less than 8 microsecond latency, and is the primary communication fabric for parallel communication. The 1200 port switched Gigabit Ethernet fabric is used for system management and job startup. System X has a peak performance of 20.24 TeraFlops with a sustained performance of 12.25 TeraFlops.VT-ARC shared-memory systems: VT-ARC currently has three SGI Altix systems which support shared-memory parallel applications, with 20, 64 and 128 processors, respectively. Anantham: A 200-node linux cluster is available to CHECS members for parallel code development and debugging, and to collaborators from the College of Engineering for production computational science and engineering applications. Associated most closely with the Laboratory for Advanced Scientific Computing and Applications (LASCA), the Anantham cluster includes 400 2.0GHz AMD Opteron processors, with 200 GB of memory and 2.0 terabytes of disk space. The nodes of the cluster are interconnected by fast Ethernet and a 2.56 Gb/s Myrinet network.Ojibwa: LASCA also houses a shared memory Sun Fire X4600 M2 Server with 8 nodes, 32 cores, 64 GB of memory, and 584 GB of disk space.

Center for Human-Computer Interaction (CHCI)

The Center for Human-Computer Interaction (CHCI; hci.vt.edu) is 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.

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.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

GRE

General Test: Verbal, Quantitative, Analytical

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 M.S degree is completed through either the thesis or the coursework option. The thesis option requires 30 credits of course work of which typically 21-24 credits must derive from courses and 6-9 credits from research work. The coursework option requires 33 credits derived from courses and a project (completed as Independent Study). Students in good standing typically complete either degree option in at most two years. The thesis option is strongly encouraged since it provides students with an in-depth research experience, and requires fewer courses. To encourage Masters graduates to exhibit sufficient breadth of computer science areas, M.S. thesis students must take CS courses spanning four (4) different areas and M.S. coursework students must take CS courses spanning five (5) different areas. At least one advanced graduate course must be included on the plan of study.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

An M.S. or Ph.D. degree may include an option in Bioinformatics. 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. These and other requirements as noted next: 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

A Graduate Certificate in Human-Computer Interaction Program is administered by the Center for Human-Computer Interaction and offered in conjunction with either a master's or doctoral degree. 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 CS degree program requirements and outside CS. Students interested in the Graduate Certificate in Human-Computer Interaction should confer with the director of the Center for Human-Computer Interaction (http://www.hci.vt.edu) prior to submitting a program of study to the Graduate School.

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

GRE

General Test: Verbal, Quantitative, Analytical

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 33 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 five (5) computer science different areas and two cognate (i.e., outside CS) courses. At least two advanced CS graduate courses must be included on the plan of study.

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. 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):

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 5104:

Computability and Formal Languages

Formal theory of computability, the halting problem, models of computation, and Church's thesis, and formal languages. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. Prerequisites or granduate standing in CSA required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (CS 4104 (UG) OR CS 5046 (UG), PPWS 5314 (UG)) OR (CS 4104 OR 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: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (CS 5024 (UG), STAT 4705 (UG)) OR (STAT 4714 (UG), STAT 4105 (UG)) OR (CS 5024, STAT 4705) OR (STAT 4714, STAT 4105)

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

Instruction Type(s): 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 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (CS 4114 (UG) OR CS 5034 (UG)) OR (CS 4114 OR CS 5034)

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 implementor. 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): MATH 5515
Corequisite(s):

CS 5465 (MATH 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

CS 5466 (MATH 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
Instruction Type(s): 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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): CS 3414 (UG) OR CS 3414
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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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

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 classsification, 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-organizating map methods. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CS 5526 (STAT 5526):

Data Analytics

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 throughly 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

Instruction Type(s): Lecture

Prerequisite(s): CS 5525 OR STAT 5525

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): null null

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 5566):

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 (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 implementaiton-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.

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 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 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. Graduate standing required. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CS 2604 (UG) OR CS 2604

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 in Computer Science and Applications (CSA).

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. Not for graduate credit for degrees in Computer Science and Applications (CSA).

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. I

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CS 5734:

Computer-supported Cooperative Work

Review and critique of state-of-the-art computing systems supporting cooperative work. Introduction to toolkits, software architectures and implementation issues relevant to development of systems for cooperative work. Analysis of group interactions and concerns in collaborative activities such as writing, design, meetings, communication, and decision-making. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):   null null

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): Lecture

Instruction Type(s): 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):   CS 2604 (UG) OR CS 2604

Corequisite(s):

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):

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 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

Instruction Type(s): Lecture

Prerequisite(s): CS 4104 (UG) OR CS 4104 OR CS 5046, GBCB 5314

Corequisite(s):

CS 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CS 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CS 5944:

Graduate Seminar

NONE

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CS 5974:

Independent Study

NONE

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):

CS 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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. I

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. II

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. I

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. II

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. Probablistic 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 uncertainy through models. Estimation of total prediction uncertainy 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. II
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 6524:

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 propogation), 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 5424G OR CS 5824
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 claculus, IP multicasting, Internet multimedia applications, and multimedia transport over wireless networks.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): CS 5565 (UG) OR CS 5565
Corequisite(s):

CS 6570 (ECE 6570):

Advanced Foundations of Newworking

This course covers theoretical foundations that are necessary for advanced study of networking. It focuses on algorithm design and optimization techniques that are most commonly used to solve complex networking problems. Major topics include complexity analysis with applications to networking problems, design and proof of approximation algorithms, design of meta-heuristic algorithms, formulation techniques for network optimization, linear and non-linear optimization techniques with applications to networking, design of distributed algorithms with proof of convergence for networks systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): CS 5565 (UG) OR ECE 5565 (UG) OR CS 5565 OR ECE 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. II
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. I
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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

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 6824:

Adv Topics Comp Biol & Bioinf

Addresses a specific advanced topic of current research interest in the area of computational biology and bioformatics (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 pre-requisites may apply.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CS 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ELECTRICAL ENGINEERING

Luke Lester, Head

Emeriti Faculty: Robert Broadwater; Gary Brown; William Davis; Douglas Lindner; Arun Phadke; Krishnan Ramu; Warren Stutzman; James Thorp;

Professors: Masoud Agah; Paul Ampadu; Peter Athanas; Scott Bailey; Aloysius Beex; Dushan Boroyevich; Richard Buehrer; Thomas Clancy; C Clauer; Gregory Earle; Dong Ha; Yiwei Hou; Michael Hsiao; Mark Jones; Jih Lai; Fred Lee; Luke Lester; Chen-Ching Liu; Guo Quan Lu; Thomas Martin; Theresa Mayer; Scott Midkiff; Lamine Mili; Khai Ngo; Mariusz Orlowski; Jung-Min Park; Paul Plassmann; Ting Chung Poon; Saifur Rahman; Sanjay Raman; Binoy Ravindran; Jeffrey Reed; Ahmad Safaai-Jazi; Timothy Sands; Wayne Scales; Patrick Schaumont; Daniel Stilwell; Joseph Tront; Yue Wang; Anbo Wang; Yong Xu; Jianhua Xuan;

Associate Professors: Amos Abbott; Joseph Baker; William Baumann; Rolando Burgos; Virgilio Centeno; Jaime De La Reelopez; Steven Ellingson; Louis Guido; Mantu Hudait; Lingjia Liu; Allen MacKenzie; Majid Manteghi; Leyla Nazhandali; Willem Odendaal; Cameron Patterson; JoAnn Paul; John Ruohoniemi; Walid Saad; Chris Wyatt; Yaling Yang;

Assistant Professors: Thidapat Chantem; Harpreet Singh Dhillon; Ryan Gerdes; Mona Ghassemi; Jia-Bin Huang; Xiaoting Jia; Vasileios Kekatos; Kwang-Jin Koh; Qiang Li; Elena Lind; Chang Woo Min; Pratap Tokekar; Ryan Williams; Yang Yi; Guoqiang Yu; Haibo Zeng; Wei Zhou; Yizheng Zhu;

Grant A. Dove Professor: Yue Wang;

Hugh P and Ethel C Kelly Professor: James Thorp;

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;

L-3 Communications Cyber Faculty Fellow: Thomas Clancy;

Roanoke Electric Steel Professorship in Engineering: Luke Lester;

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NCR Graduate Coordinator: roxpaul@vt.edu

Student Handbook: http://www.ece.vt.edu/gradman/manual.php

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. All 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). For the master's degree, each plan of study, developed by the student in consultation with his or her faculty advisor, must contain a limited number of core courses. The M.S. degree program requires a thesis. The M.Eng. is a non-thesis degree program and is especially suitable for part-time graduate students employed as engineers by industry and government agencies.The Ph.D. degree program is research-oriented. Applicants applying for these degrees program must have an earned Master's degree in CPE, EE or related field. A direct-Ph.D. option is available for students without an earned Master's degree. These students will earn a Master of Science, Thesis, or Master of Science, Non-Thesis, degree in addition to the Ph.D. The Bradley Department of Electrical and Computer Engineering's current enrollment is approximately 535 students. Out of the enrolled students, approximately 95% of our full-time Ph.D. students are funded and approximately 75% of our full-time Master's student are funded.Funding is available in three ways: Graduate Teaching Assistantships - Awarded by the department Graduate Research Assistantships - Awarded by individual faculty Fellowships - Awarded by the department to the top applicants to the program. Of the fellowships awarded by the department, the Bradley 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: (96.0)

GRE

General Test: Verbal (153.0), Quantitative (157.0), Writing (4.5)

IELTS

General: Band (7.5)

32 credit hours 27 credit hours of course work 3 credit hours of project and report 2 credit hours of seminar 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)

32 credit hours 21 credit hours of course work 9 credit hours of research and thesis 2 credit hours of seminar The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

PhD Degree

Regular PhD Requirements (for students with an earned Masters):92 credit hours 30 credit hours of course work 60 credit hours of research and thesis 2 credit hours of seminar Direct-PhD Requirements (for students with only an earned Bachelors):MS, Thesis and PhD - 92 credit hours 21 credit hours of coursework for MS (all transfer to PhD) 9 additional credit hours of coursework for PhD 9 hours of research and thesis for MS 60 credit hours of research and dissertation for PhD 2 credit of seminar that will count for both MS and PhD MS, Non-Thesis and PhD - 92 credit hours 30 credit hours of coursework for MS (all transfer to PhD) 60 credit hours of research and dissertation for PhD 2 credit of seminar that will count for both MS and PhD The ECE Graduate Student Policy Manual gives detailed information pertaining to degree requirements.

GRADUATE COURSES (ECE)

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 amplifer design. Microwave Integrated Circuits (MIC). RF Microelectromechincal System (MEMS) components. Microwave systems. RF components for wireless systems. RF components for Ultra Wide band (UWB) systems. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECE 5105:

Electromagnetic Waves

5105: Fundamentals of pane wave propagation, reflection, and transmission; basic theorems, equivalent currents, and Green's 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): null null

Corequisite(s):

ECE 5106:

Electromagnetic Waves

5105: Fundamentals of plane wave propogation, reflection, and transmission; basic theorems, equivalent currents, and Green's 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): (ECE 3106 (UG), ECE 3614 (UG)) OR (ECE 3106, ECE 3614)

Corequisite(s):

ECE 5164:

Introduction to Space Science I: The Solar Wind and Magnetosphere

Describes the space environment from the sun to the earth's 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 resistivtiy, 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 Earth's environment and their implementation in engineering systems; societal applications of remote sensing; fundamental principles of electromagnetic wave propogation 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 distribtutions; 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

Instruction Type(s): 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

Instruction Type(s): 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. 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):

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

Instruction Type(s): 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 5220:

Radio Frequency Integrated Circuit Technology and Design

Integrated circuit (IC) implementation of RF circuits for wireless communications applications. Transceiver architectures for current wireless communications standards; active/pasive device technologies for RFIC implementations; low noise amplifiers; mixers; frequency sources; power amplifiers; single-chip radios; and RFIC packaging and testing. Case studies of modern RFIC chip sets for current wireless communications standards are examined. The course involves circuit design at the IC level; modern RF/microwave CAD software will be used in conjunction with the course. Design of a wireless transceiver

functional block component RFIC chip. Alternate years. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): (ECE 3204 (UG), ECE 3614 (UG)), (ECE 4605 (UG) OR ECE 4104 (UG)) OR (ECE 3204, ECE 3614), (ECE 4605 OR ECE 4104)
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
Instruction Type(s): Lecture
Prerequisite(s): null null
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
Instruction Type(s): 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. II
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
Instruction Type(s): 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. II

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. I

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:

Electric Machines and Transients

Development of inductances, flux linkages, voltage equations, linear transformations, continuous simulation techniques, and machine models. Transients on transmission lines, transformers, and machines. Arcing and restriking phenomena. Lightning arresters and insulation coordination. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECE 4314 (UG) OR ECE 4314

Corequisite(s):

ECE 5374G:

Adv Alternate Energy Systems

Electric energy from alternative energy sources including solar, wind, hydro, biomass, geothermal and ocean. Chacteristics 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. 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 5424G:

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, strucutred 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. (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):

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 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. (3H,3C)

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 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 teh 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 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 Fault-tolerant Computing

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

Instruction Type(s): Lecture

Prerequisite(s): ECPE 4505

Corequisite(s):

ECE 5506:

Testing and Fault-tolerant Computing

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

Instruction Type(s): 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 5520:

Secure Hardware Design

Design and implementation of secure hardware at multiple levels of abstractions, covering cryptographic hardware primitives, cryptographic hardware primitives, cryptographic modules using passive attacks, active attacks, and cryptanalytic techniques. Countermeasures against reverse engineering. The course uses case studies and literature surveys to reflect on the state-of-the-art in secure hardware implementation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECE 4514 (UG) OR ECE 4514

Corequisite(s):

ECE 5530:

Configurable Computing

The design and implementation of high-performance computing machinery using configurable computing technology is studied. Contemporary computing methodologies are investigated, modeled, and constructed in laboratory exercises. Computational solutions are implemented by using field programmable gate arrays and adaptive computing devices.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (ECE 4514 (UG), ECE 5504 (UG)) OR (ECE 4514, ECE 5504)

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 profiiciency in programming and modeling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECE 4514 (UG) OR ECE 4514

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

Instruction Type(s): 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 prograaming 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

Instruction Type(s): 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): null null

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

Instruction Type(s): 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 5566):

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 5574G:

ADV Software Development CAE

Computer-aided engineering software that address the hierarchy of engineering analysis, design, and decision evaluation is developed with state-of-the-art computer tools. Linear graph theory is applied to the modeling of physical networks. Operator overloading, dynamic polymorphism, graphical user interfaces, dynamic link libraries, and multiple threaded programs are considered. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ECE 5575:

Object-Oriented Software Devel

Use cases, class models, state models, interaction modeling, constraint modeling, message design, and concurrent and real-time systems. Students develop analysis documentation for an Engineering related project.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4574 (UG) OR ECE 4574

Corequisite(s):

ECE 5576:

Object-Oriented Software Devel

Object-oriented design, including both logical and physical design. In logical design, rules related to class interfaces, containment, inheritance, and associations are covered along with design patterns. Physical design addresses components, levelized designs, and the application of generic programming concepts in design. Students develop design documentation for an engineering software project.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 4574 (UG) OR ECE 4574

Corequisite(s):

ECE 5580 (CS 5580):

Cryptopgraphic 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.

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 5585:

IT Security and Trust

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 techiniques. 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 5586:

IT Security and Trust

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.

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 5604:

Computer-Aided Design and Analysis of Communication Systems

Simulation techniques for communication systems operating in random environments. Simulation models for stochastic signals and system components including coders, decoders, modulators, non-linear amplifiers, bit and carrier synchronizers, equalizers and receivers. Techniques for modeling time-varying channels. Monte Carlo simulation, semi-analytic simulation and variance reduction techniques applied to the analysis, design and performance evaluation of communication systems. Programming experience required.

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), STAT 4714 (UG)) OR (ECE 4624, ECE 4634, STAT 4714)

Corequisite(s): ECE 5605

ECE 5605 (BMES 5525):

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. I

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

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. II

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. I

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 velcoity, 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): null null

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 5665:

Telecommunications

5665: Basic concepts in electrical engineering. Waveforms, spectra bandwith. Fourier series and tansform. Decibels, SNR, BER. Analog and digital transmission and modulations. Wire and radio links, link budgets, SNR and BER. Pre: Graduate standing. 5666: Analog modulations, AM, FM. Digital Modulations, ASK, FSK, PSK, QAM. RRC filtering, digital transmissions. Multiplexing, multiple access. Error control, FEC, ARQ. Local area networks. Optical communication systems. Satelite communcations, GPS.

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 5666:

Telecommuncations

5665: Basic concepts in electrical engineering. Waveforms, spectra bandwith. Fourier series and transform. Decibels, SNR, BER. Analog and digital transmissions and modulations. Wire and radio links, link budgets, SNR and BER. Pre: Graduate standing 5666: Analog modulations, AM, FM. Digital Modulations, FSK, PSK, QAM. RRC filtering, digital transmission. Multiplexing, multiple access. Error control, FEC, ARQ. Local area networks. Optical communication systems. Satelite communications, GPS.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ECE 5665

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 5684:

Error Control Coding

Use of error control codes to improve the reliability of digital communication and storage systems in the presence of noise. Algebraic structure of codes over finite fields. Error detecting and correcting codes. Block codes and convolutional codes, including Reed Solomon codes, LDPC codes, and turbo codes. Pre: Graduate standing.

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 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 (CS 5584):

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
Instruction Type(s): 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.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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 (AOE 5764) (ME 5564):

Applied Linear Control

Analysis and design of sampled-data systems, extracton 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.

Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

Instruction Type(s): 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):

ECE 5894:
Final Examination
NONE
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ECE 5904:
Project and Report
NONE
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 5914:
Autonomous Systems Seminar
Weekly technical presentations from local and visiting scholars on current topics related to the theory, design and development, and application of autonomous vehicle systems. Pre-requisite: Graduate Standing required
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture
Instruction Type(s): Lecture
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. I,II
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ECE 5974:
Independent Study
NONE
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):

ECE 5984:
Special Study
NONE
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
NONE
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
Instruction Type(s): Lecture
Prerequisite(s): ECE 5105
Corequisite(s):

ECE 6114:

Advanced Analytical Electromagnetics

This course comprises PhD-level material covering exact and asymptotic analytical techniques for the solution of advanced electromagnetic problems involving wave propagation and scattering by finite and extended media inhomogenieties.
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 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 confiurations, 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, Green's 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 tranmission 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
Instruction Type(s): Lecture

Prerequisite(s): ECE 5105
Corequisite(s):

ECE 6174 (AOE 6174):
Computational Plasma Dynamics
Computational techniques for intestigating 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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. 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):

ECE 6314:
Advanced Instrumentation in Power Systems
Role of advanced instrumention 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
Instruction Type(s): 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. II
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- maching 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 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):

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:

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 propogation), 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 5424G OR CS 5824
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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): ECE 5565 (UG) OR ECE 5565
Corequisite(s):

ECE 6570 (CS 6570):

Advanced Foundations of Networking

This course covers theoretical foundations that are necessary for advanced study of networking. It focuses on algorithm desidn and optimization techniques that are most commonly used to solve complex networking problems. Major topics include complexity analysis with applications to networking problems, design and proof of approximation algorithms, design of meta-heuristic algorithms, formulation techniques for network optimization, linear and non-linear optimization techniques with applications to networking, design of distributed algorithms with proof of convergence for networks systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ECE 5565 (UG) OR CS 5565 (UG) OR ECE 5565 OR CS 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

Instruction Type(s): 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-invarient 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 (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

Instruction Type(s): Lecture

Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)

Corequisite(s):

ECE 6984:

Special Study

NONE

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

NONE

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

Professor: Jennifer Case; Vinod Lohani; Elizabeth McNair; Marie Paretti; Bevlee

Watford;

Associate Professor: Brenda Brand; Jeremy Ernst; Holly Matusovich; Matthew Wisnioski;

Assistant Professor: Liesl Baum Walker; Nicole Pitterson; Denise Simmons;

Affiliated Faculty: Liesl Baum Walker; Brenda Brand; Jeremy Ernst; Denise Simmons; Matthew Wisnioski;

Research Professors: Jennifer Case; Vinod Lohani; Elizabeth McNair; Marie Paretti; Bevlee Watford;

Research Associate Professors: Holly Matusovich;

Research Assistant Professors: Nicole Pitterson;

Graduate Contact: lindawh@vt.edu

Graduate Site: http://enge.vt.edu/graduateprogram.html

Graduate Student Manual: http://enge.vt.edu/content/dam/enge_vt_edu/EngE_GraduateManual_1617.pdf

The Engineering Education PhD program incorporates theory and practice so that its students are prepared to be teachers and scholars in the emerging field of engineering education. We incorporate theory with applied practice to prepare students for a wide range of careers: Engineering policy Corporate training management University assessment University administration Education in academia and K-12 Research and scholarship Graduates of the doctoral program will be able to conduct and direct research in engineering education, develop, review, and critique effective research designs, effectively teach engineering subjects, design and assess engineering courses, and address critical issues facing engineering education.The Engineering Education Graduate Program also offers a 13-credit Graduate Certificate. Course offerings overlap significantly with those of the Engineering Education PhD and the Graduate School's Professoriate Certificate.Our Mission: to support the critical role of engineering in societal and global development to improve the synergistic role of education research, teaching, practice, and advising in engineering to promote the value of and need for educating and developing engineering professionals

SPECIAL FACILITIES

The Department of Engineering Education has cultivated core research strengths in professional skills such as interdisciplinary, communication, collaboration, design education, motivation, global issues, and first year courses (particularly learning technologies). Retention, diversity, and assessment are important foundational concepts in the field of engineering education; as such, they are elements of all our projects.

(EC)3 Lab

The (EC)3 Lab is directed by Dr. Jake 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. 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. 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.

DEEP Lab

The VT DEEP Lab–Data Enhanced Educational Practice– is directed by Dr. David Knight. This lab is comprised of a collaborative team of researchers who work in interdisciplinary ways across the university. Spanning the “grade school-to-graduate school” continuum, our work tends to be at the macro-scale, and we investigate multiple aspects of the system (i.e., curriculum, co-curriculum, and organizational contexts) to understand how to help students achieve a variety of outcomes. Three themes characterize our research:1) Investigate organizational contexts, educational environments, and student experiences that support the development of diverse engineers who can become interdisciplinary problem-solving leaders across global contexts.2) Identify mechanisms to enhance existing organizational decision-making processes through the incorporation of local data.3) Leverage existing, large-scale data sets or collect new data in innovative ways to create intelligent feedback loops by connecting data, processes, and outcomes.Using these broad areas of focus as a guide, our research works toward improving the efficiency, effectiveness, and inclusiveness of the engineering and STEM education system.

GUIDE Research Group

GUIDE is directed by Dr. Walter Lee and consists of undergraduate and graduate students. It is a collaborative effort between researchers and student-support practitioners. Our mission is to advance understanding of the role that diversity plays in engineering, actively and intentionally connecting research to practice. Members of GUIDE (1) conduct practice-informed research, focused on identifying areas of opportunity to advance diversity and inclusion; and (2) develop and evaluate research-based solutions for making engineering a more accessible and supportive environment.

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

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.Co-Directors: Dr. Lisa McNair & Dr. Marie Paretti

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

GRE

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. Quantitative Research Methods: 3 credits Qualitative Research Methods: 3 credits Education: 9 credits Engineering Education core courses: 12 credits Engineering Concentration: 15 credits Electives: 6 credits 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. Up to 30 credits from a Master's degree may be counted toward the PhD at the discretion of the student's advisory committee. Students must enroll in ENGE 5704: Engineering Education Graduate Seminar (1 credit) each semester. More detailed information regarding degree requirements is available in the Engineering Education Graduate Manual.

GRADUATE COURSES (ENGE)

ENGE 5014:

Foundations of Engineering Education

This course addresses foundational principles of engineering education through relevant theories of teaching and learning, curriculum development, assessment, and student development. Broad categories of engineering courses (laboratories, design courses, and lectures) are examined with respect to course design, learning objectives, instructional methods, and assessment and accreditation. Students will learn to apply research- and theory-based educational methods to develop course materials and assess learning consistent with engineering accreditation standards. Graduate standing and completion of 6 credits of ENGE or related coursework with consent of instructor 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 5024:

Design in Engineering Education and Practice

This course is focused on preparing future engineering faculty members and practitioners to teach engineering design as well as how to function more effectively in industry design environments. Material related to theories of student learning and appropriate pedagogical approaches to teaching an open-ended subject such as engineering design will be included. Student mentoring of design teams will be a key feature. Guest speakers from industry, academia, and government organizations will supplement the course work. Graduate standing in any department at Virginia Tech required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ENGE 5404:

Assessment Techniques in Engineering Education

Assessment issues and skills important for engineering faculty or staff members at a college or university are addressed, including the strengths and weaknesses of a variety of quantitative and qualitative assessment strategies. Assessment is framed as an integrated part of course design, and ABET engineering accreditation criteria and procedures are discussed in-depth. Students will design and conduct an assessment in engineering course and learn important considerations in coordinating department or college resources in preparation for an ABET review.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture
Prerequisite(s): ENGE 5014
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
Instruction Type(s): Lecture
Prerequisite(s):
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
Instruction Type(s): 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 including recruitment of minorities, retention issues, technology integration into engineering curricula, distance learning, engineering content into K-12 curriculum, 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. Graduate standing required.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): ENGE 5604
Corequisite(s):

ENGE 5974:

Independent Study

NONE
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):

ENGE 5984:

Special Study

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 10
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s):
Corequisite(s):

ENGE 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s): ENGE 5014, ENGE 5604

Corequisite(s):

ENGE 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ENGINEERING MECHANICS

Pamela VandeVord, Interim Head

Emeriti Faculty: Norman Dowling; John Duke; John Grant; Mahendra Singh;

Professors: Romesh Batra; Scott Case; Mark Cramer; Rafael Davalos; David Dillard; Thomas Dingus; Stefan Duma; Hampton Gabler; Robert Gourdie; Muhammad Hajj; John Lesko; Steven McKnight; Saad Ragab; Shane Ross; Mark Stremler; Pamela VandeVord;

Associate Professors: Raffaella De Vita; Zachary Doerzaph; Scott Hendricks; Sunghwan Jung; Stephen LaConte; Yong Lee; Steven Poelzing; Robin Queen; John Socha; Anne Staples; Surot Thangjitham; Costin Untaroiu; Mark Van Dyke; Vincent Wang;

Assistant Professors: Nicole Abaid; Jonathan Boreyko; Guohua Cao; John Chappell; John Domann; Hosein Foroutan; James Hanna; Andrew Kemper; Alexei Morozov; Jennifer Munson; Steven Rowson; Shima Shahab; Alexandrina Untaroiu; Scott Verbridge; Eli Vlaisavljevich;

Affiliated Faculty: Alan Asbeck; Jonathan Black; Tomonari Furukawa; Scott Huxtable; Rakesh Kapania; Rolf Mueller; Alexey Onufriev; Robert Parker; Mayuresh Patil; Gary Seidel; Saied Taheri; Pablo Tarazaga; Leigh Winfrey; Craig Woolsey;

Clifton C. Garvin Professor: Romesh Batra;

Reynolds Metals Professor: Scott Case;

Adhesive & Sealant Science Professor: David Dillard;

J. Byron Maupin Professor: Muhammad Hajj;

Engineering Science and Mechanics Program Chair: Scott Hendricks;

L. Preston Wade Professor: Rafael Davalos;

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

L.S. Randolph Professor: Robert Parker;

Harry C. Wyatt Professor, ICTAS Director: Stefan Duma;

Samuel Herrick Professor: Hampton Gabler;

N. Waldo Harrison Professor: Pamela VandeVord;

Newport News Shipbuilding Professor, VTTI Director: Thomas Dingus;

Graduate Contact: esmgradinfo@vt.edu

Graduate Site: http://www.beam.vt.edu

The Engineering Mechanics (EM) program provides a strong foundation and sturdy framework for the discovery, development, transfer, and implementation of new 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 environment for strong undergraduate and graduate education that emphasizes fundamental understanding, high-quality teaching, frontier-level research, innovation, and service to the professional mechanics community. Instilling EM graduates with a highly flexible professional perspective enables them to pursue successful careers in a variety of engineering industries, in research environments, and in higher education. Indeed, EM graduates now populate prominent engineering departments across the nation and are transmitting the values of their engineering science training to new generations of students. Our graduates also serve as science and technology advisors to local, regional, and federal governmental organizations; hold leadership positions in professional societies; and are active participants in public discourse on the role and value of engineering science in relation to the research and educational 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.

To view all of our labs and facilities, visit: http://www.beam.vt.edu/research/index.php Information about some of our labs and facilities:

Bio-Inspired Fluids Lab Sunny Jung, PI Our group has research interests in various physical problems related to fluid-structure interaction, including bio-locomotion, interfacial dynamics, and fluid-elasticity coupling. If you are interested in any of our research, please contact Prof. Jung at sunnyjsh@vt.edu. 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.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. Damage Science and Mechanics John Duke, Jr, PI In order to assure the safety and reliability of critical assets understanding the science of how systems degrade and how this damage affects performance is critical. 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, system and structural health monitoring are areas where this work finds applications.Kevin P. Granata Biomechanics Lab Robin Queen, PI The Kevin P. Granata Biomechanics Lab is the current center of research for Robin Queen, who is a fellow of the American College of Sports Medicine. She was previously the director of the "Coach K" Lab at Duke University where she worked with a variety of industry sponsors including the Nike Sport Research Lab and DonJoy Orthopedics. Her focus is on lower extremity biomechanics with an emphasis in foot and ankle biomechanics. Her work focuses on understanding changes in lower extremity loading and movement symmetry that result from injury and pathology. In addition, Dr. Queen works on development of various interventions to restore movement and loading symmetry in an attempt to decrease future risk of joint damage and prevent subsequent injuries. LAB James Hanna, PI Nonlinear classical mechanics, particularly dynamics of thin structures. Some recent topics include: impact of flexible objects; equilibria and snap-through bifurcations of cables, strips, and sheets; geometric singularities; multi-stable and collapsing structures.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 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.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 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.MultiSTEPS IGERT Mark Stremler, PI MULTISCALE TRANSPORT IN ENVIRONMENTAL AND PHYSIOLOGICAL SYSTEMS: The MultiSTEPS program aims to prepare future leaders of industrial and academic research to think, collaborate, and solve problems at the intersection of the engineering and biological sciences.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. Dr. Ross is the Director and Recruiting Coordinator of BIOTRANS, an interdisciplinary graduate education program to cross-train graduate students in biology and engineering to work on biological transport problems in environmental and physiological systems.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

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 5994 Research and Thesis (at least 6 credits) 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) MS students must also register for at least two semesters for one credit hour of 5944 Seminar. 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. 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 register for at least two semesters for one credit hour of 5944 Seminar. 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.

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

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 5904 Project and Report (3 credits) 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) MEng students must also register each semester for one credit hour of 5944 Seminar. 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

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

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

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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:

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

Instruction Type(s): 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 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ESM 3054

Corequisite(s):

ESM 5174 (BMES 5124):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ESM 5245G:

Mechanics Animal Locomotion

The mechanical and biological principles of animal locomotion. Compartative 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ESM 3054 OR ESM 5654)

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

ESM 5306 (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

Instruction Type(s): Lecture

Prerequisite(s): ESM 4106

Corequisite(s):

ESM 5314:

Intermediate Dynamics

Review of Newtonian mechanics, fundamental concepts of analytical mechanics, Hamilton's principle, Lagrange's equations, rigid-body dynamics, Euler's equations, gyroscopic principles, definitions of stability, geometric theory (phase-plane trajectories), limit cycles, state-space analysis, Routh-Hurwitz criterion, Liapunov direct method. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. (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):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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): 0 OR 3

Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, 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): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): ESM 5014
Corequisite(s):

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 4425

Corequisite(s):

ESM 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): MATH 2214 OR MATH 2514 OR MATH 4544

Corequisite(s):

ESM 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ESM 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

NONE

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):

ESM 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ESM 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ESM 5014

Corequisite(s):

ESM 6314:

Advanced Dynamics

Fundamental concepts of analytical mechanics, variational principles, Lagrange's equations, rigid-body kinematics and dynamics, Euler parameters, quasi-coordinates, Euler's equations, gyroscopic systems, Hamilton-Jacobi equation, transformation theory, introduction to optimal control theory, advanced concepts in stability theory. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ESM 4734 OR ESM 5734

Corequisite(s):

ESM 6974:

Independent Study

NONE

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):

ESM 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ESM 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ENVIRONMENTAL ENGINEERING

William Easterling, Head

Emeriti Faculty: Gregory Boardman; William Cox; John Novak;

Professors: Andrea Dietrich; Daniel Gallagher; Zhen He; Jennifer Irish; William Knocke; John Little; Amy Pruden-Bagchi; Mark Widdowson;

Associate Professors: Erich Hester;

Assistant Professors: Nina Stark; Zhiwu Wang;

Research Associate Professors: Adil Godrej;

W. Thomas Rice Professor: Amy Pruden-Bagchi;

W. Curtis English Professor: William Knocke;

Charles E. Via, Jr. Professor: John Little;

Assistant Professor of Practice: Robert Scardina; Kevin Young;

Graduate Contact: shamrtin@vt.edu

Extended Campus: shmartin@vt.edu

Student Handbook: https://www.cee.vt.edu/wp-content/uploads/2017/07/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

Graduate Site: https://www.cee.vt.edu/prospective-graduate-students/

National Capital Region: https://ncr.vt.edu/about/index.html

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/).National Capital Region web site: http://www.cee.vt.edu/other-campuses/

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 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, ICTAS I & II, 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 environmental engineering program also includes the Occoquan Monitoring Laboratory (Manassas, Virginia), where research focuses on wastewater reuse, reservoir eutrophication control, and watershed monitoring and management. Web site:www.owml.vt.edu

DEGREES OFFERED

MS Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (570.0)

iBT: (88.0)

GRE

General: Verbal, Quantitative, Analytical

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 http://www.cee.vt.edu/wp-content/uploads/2016/08/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

GRADUATE COURSES (CEE)

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): null null

Corequisite(s):

CEE 5014:

Facility Delivery & Financing

Delivery and financing of constructed facilities with an emphasis uopn 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 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 reducting costs and easing the burden of dispute resolution. Techniques for quantifying and resolving claims are studied. 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):

CEE 5074:

Global Virtual Design and Construction

Fundamental aspects of modern civil engineering project execution in vitual workspaces. Participation in team-based vitrual 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/cutures. Both theory and practice emphasized. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CEE 5080:

Infrastructure Asset Mgt

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 techology, database and data analysis software applciations 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): null null

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

Instruction Type(s): 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): null null

Corequisite(s):

CEE 5124:

Fundamentals of Environmental Toxicology

Introduction to nomenclature, principles, and scope of environmental toxicology. The fate and effects of both organic and inorganic toxicants in the environment, in animals, and in various test systems. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CEE 5104 (UG) OR CEE 5104

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): null null

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 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): null null

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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): (CEE 5125 (UG) OR CEE 5126 (UG)) OR (CEE 5125 OR CEE 5126)

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
Instruction Type(s): 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 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
Instruction Type(s): 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): 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):

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. 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):

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.
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:

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

Instruction Type(s): Lab, Lecture
Prerequisite(s): null null
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 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 be drawn from environmental and water resources topics. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
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
Instruction Type(s): Lecture
Prerequisite(s): null null
Corequisite(s):

CEE 5324:

Advanced Hydrology

Applications of statistics to hydrology, floods, and droughts; flow generation models; mathematical models in physical hydrology; difference methods in flow routing; kinematic wave; evapo-transpiration; infiltration; and atmospheric processes. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
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
Instruction Type(s): Lecture
Prerequisite(s): null null
Corequisite(s):

CEE 5354 (GEOS 5814):

Numerical Modeling of Groundwater

Thoery 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 BC's and IC's. 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5364:

Water Law

Analysis of law for allocation of surface and groundwater supplies, legal controls over water quality alteration, public rights of water use, and drainage law. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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): null null

Corequisite(s):

CEE 5384:

Transport Processes in Waterways

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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 standars. Pre: Graduate Standing.

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CEE 5424:

Computer Analysis of Structures II

Extension of matrix displacement method to skeletal space structures: space trusses, space frames, and grids. Incorporation of special features such as nonglobal constraints, assemblies of different types of elements,

thermal problems, substructuring, and buckling analysis. Development of well-structured programs on the mainframe and transfer to the personal computer. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
Corequisite(s):

CEE 5424G:

Intermediate Design of Prestressed Concrete Structures

Principle of prestressing applied to concrete beams, slabs, and frames; design of individual elements and structural systems of presresseed concrete; precast construction and connection design. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

CEE 5434:

Design of Cold-formed Steel Structures

Behavior and design of cold-formed steel members. Strength of thin plate elements; flexural members; compression members, symmetric and non-symmetric; beam-columns; welded, bolted, and screw-fastened connections. Building systems that utilize cold-formed steel members. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): null null
Corequisite(s):

CEE 5444:

Stability of Structures

Methods of static structural stablity 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
Instruction Type(s): Lecture
Prerequisite(s): null null
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 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
Instruction Type(s): Lecture
Prerequisite(s): null null
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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5474G:

Intermediate Reinforced Concrete Structures

Behavior and design of continuous reinforced concrete structures subjected to gravity and lateral loads. Application of computer programs to frame analysis and design of members. Development length, biaxial bending of columns, continuous one-way beams and slabs, two-way floor systems, torsion, footing, and cantilever retaining wall design problems. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5504:

Risk Analysis Geotechnical Engineering

Methods for risk analysis of complex systems. Basic concepts of probabliity and reliability applied to geotechincal 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

Instruction Type(s): Lecture

Prerequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CEE 5514 (UG) OR CEE 5514

Corequisite(s):

CEE 5574:

Environmental Geotechnics

Geotechnical aspects of environmental engineering projects. Fundamentals of soil behavior, site characterization, and contaminant transport; methods for geotechnical engineering practice for waste disposal, waste containment, and site remediation; waste landfills. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): 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 attirbute 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): 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):   null null

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 5620:

Transportation Network Analysis

Optimal paths in transportation networks, transportation network design, vehicle routing and scheduling, facility location problems, traffic flows on networks, traffic assignment 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):

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):   null null

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):   null null

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):   null null

Corequisite(s):

CEE 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. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

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): null null

Corequisite(s):

CEE 5660:

Trans Risk, Reliab & Security

Transportation risk assessment and computation; evacuation modeling; reliability analysis; infrastructure interdependency analysis; network impact 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): null null

Corequisite(s):

CEE 5674:

Advanced Pavement Design

Methods used to characterize, stabilize, and specify pavement materials. Methods for rigid and flexible highway and airport pavement design and analysis. Load equivalence factor and specific design considerations related to environment and traffic characteristics. Pavement overlay design. Software for pavement design and analysis using various models. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5684:

Rehabilitation of Transportation Structures

Identification of maintenance and rehabilitation needs for transportation structures such as bridges and pavements. Cost effective maintenance and rehabilitation methods. Consideration of bridge and pavement management systems. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

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 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): 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):

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 5774:

Hazardous Waste Management

Review of regulatory framework governing hazardous waste management. Characteristics of hazardous wastes. Fundamental physical, chemical, and biological principles applied to the design of treatment processes. Risk management. Case studies. Design project. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s): CEE 5104

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): 0 OR 3

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): null null

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): null null

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 liquefication as a consequence of cyclic loadings adn 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:

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 Estuarine Morphodyn

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 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

CEE 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

CEE 5944:

Seminar

Review and discussion of current literature, research, and consulting activities by student, faculty, and guest speakers. I,II

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

NONE

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):

CEE 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CEE 5154

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

CEE 6504:

Theoretical Soil Mechanics

Constitutive Laws for Soils, nonlinear elastic and plastic models. Consolidation, layered systems, sand drains, approximate three-dimensional theories, and Biot's poro-elastic formulation. Plastic equilibrium in soils Sokolovski's 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): CEE 5514 (UG) OR CEE 5514

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

NONE

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

NONE

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

William Easterling, Head

Emeriti Faculty: Gregory Boardman; William Cox; John Novak;

Professors: Andrea Dietrich; Daniel Gallagher; Jennifer Irish; William Knocke; John Little; Amy Pruden-Bagchi; Mark Widdowson;

Associate Professors: Erich Hester; Kyle Strom;

Assistant Professors: Nina Stark; Zhiwu Wang;

Research Associate Professors: Adil Godrej;

W. Curtis English Professor: William Knocke;

Charles E. Via Jr. Professor: John Little;

W. Thomas Rice Professor: Amy Pruden-Bagchi;

Assistant Professor of Practice: Robert Scardina; Kevin Young;

Graduate Contact: shmartin@vt.edu

Extended Campuses: shmartin@vt.edu

Graduate Site: https://www.cee.vt.edu/prospective-graduate-students/

Graduate Policy: https://www.cee.vt.edu/wp-content/uploads/2017/07/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

National Capital Region: https://ncr.vt.edu/about/index.html

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, ICTAS I & II, 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 environmental science and engineering program also includes the Occoquan Monitoring Laboratory (Manassas, Virginia), where research focuses on runoff pollutant effects on receiving waters, reservoir eutrophiction control, and watershed monitoring and management. Web site: www.owml.vt.edu

DEGREES OFFERED

MS Degree

Offered In (Virtual, Blacksburg, National Capital Region)

TOEFL

Paper: (570.0)

iBT: (88.0)

GRE

General: Verbal, Quantitative, Analytical

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:http://www.cee.vt.edu/wp-content/uploads/2016/08/Graduate-Policies-and-Procedures-Manual-Departmental.pdf

INDUSTRIAL AND SYSTEMS ENGINEERING

Eileen Van Aken, Interim Head

Professors: Jaime Camelio; John Casali; Brian Kleiner; Maury Nussbaum; Subhash Sarin; Gaylon Taylor; Konstantinos Triantis; Eileen Van Aken;

Associate Professors: Douglas Bish; Ebru Bish; Deborah Dickerson; Kimberly Ellis; Joseph Gabbard; Lawrence Harmon; Philart Jeon; Sheila Klauer; Zhenyu Kong; John Shewchuk; Michael Taaffe;

Assistant Professors: Manish Bansal; Xi Chen; Navid Ghaffarzadegan; Robert Hildebrand; Niyousha Hosseinichimeh; Ran Jin; Blake Johnson; Hanumanthrao Kannan; Nathan Lau; Alejandro Salado Diez; Divya Srinivasan; Weijun Xie; Xiaowei Yue;

Rolls Royce Commonwealth Professor of Advanced Manufacturing: Jaime Camelio;

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;

Main Campus Graduate Program Contact: hsswiger@vt.edu

Off Campus Graduate Program Contact: pcuren@vt.edu

Graduate Site: https://www.ise.vt.edu/academics/graduate.html

Main Website: https://www.ise.vt.edu/index.html

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 (M.S.), Engineering Administration (M.E.A.), and Systems Engineering (M.S.).

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:
http://www.ise.vt.edu/ResearchFacilities/ResearchFacilities_index.html

Affiliates

http://www.ise.vt.edu/ResearchFacilities/Affiliates/Affiliates_index.html

Centers

http://www.ise.vt.edu/ResearchFacilities/Centers/Centers_index.html

Labs

http://www.ise.vt.edu/ResearchFacilities/Labs/Labs_index.html

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

TOEFL

Paper: (550.0)

iBT: (80.0)

MS (non-thesis) must take 30 hours of coursework beyond the B.S. MS (thesis) must take 30 hours with a minimum of 20 hours of course work beyond the B.S..

Degree Concentrations:

Human Factors Engineering and Ergonomics

http://ise.vt.edu/GraduatePrograms/MS/HFEE/MS_HFEE_index.html

Mangement Systems Engineering

http://ise.vt.edu/GraduatePrograms/MS/MSE/MS_MSE_index.html

Manufacturing Systems Engineering

http://ise.vt.edu/GraduatePrograms/MS/ManufacturingSystems/MS_ManuSystems_index.html

Operations Research

http://ise.vt.edu/GraduatePrograms/MS/OR/MS_OperationsResearch_index.html

General Industrial Engineering

http://ise.vt.edu/GraduatePrograms/MS/IE_Option/MS_IEOption_index.html

PhD Degree

Offered In (Blacksburg)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

TOEFL

Paper: (550.0)

iBT: (80.0)

PhD students must take 90 hours with a minimum of 45 hours of course work beyond the B.S.

Degree Concentrations:

Human Factors Engineering

http://www.ise.vt.edu/academics/graduate/phd/hfee/index.html

MEA Degree

Offered In (Roanoke, Southwest Virginia, Hampton Roads, Richmond, National Capital Region, Leesburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

30 credit hours beyond the bachelors degree.

Degree Concentrations:

Master of Engineering Administration

http://www.ise.vt.edu/academics/extended/mea/index.html

PhD Degree

Offered In (National Capital Region)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

TOEFL

Paper: (550.0)

iBT: (80.0)

PhD must take 90 hours with a minimum of 45 hours of course work beyond the B.S.

Degree Concentrations:

Management Systems Engineering

http://www.ise.vt.edu/academics/extended/phd/index.html

MS Degree

Offered In (Roanoke, Southwest Virginia, Hampton Roads, Richmond, National Capital Region, Leesburg)

GRE

General: Verbal (146.0), Quantitative (151.0), Analytical (3.0)

TOEFL

Paper: (550.0)

iBT: (80.0)

MS (non-thesis) must take 30 hours of coursework beyond the B.S.

Degree Concentrations:

Systems Engineering

http://www.ise.vt.edu/academics/extended/syseng/index.html

GRADUATE COURSES (ISE)

ISE 5015:

Management of Change, Innovation, and Performance in Organizational Systems

The management (planning, measurement and evaluation, control, and improvement) of organizational systems (work groups, departments, functions, plants, and companies). 5015: Managing performance, change, and innovation in organizational systems. 5016: Measurement and evaluation of performance or organizational systems. 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):

ISE 5016:

Management of Change, Innovation, and Performance in Organizational Systems

The management (planning, measurement and evaluation, control, and improvement) of organizational systems (work groups, departments, functions, plants, and companies). 5015: Managing performance, change, and innovation in organizational systems. 5016: Measurement and evaluation of performance or organizational systems. 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):

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. I

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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): ISE 5034, ISE 5405

Corequisite(s):

ISE 5104:

Operations Research

Basic techniques and methods of Operations Research are presented. The course will cover the phases of problem identification, model building and analytical methods of decision making. Students will be introduced to the implementation of these algorithms and models. Not for credit for students pursuing the M.S. or Ph.D. in the O.R. 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 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:

Management of Quality and Reliability

This course presents the managerial and mathematical principles and techniques of planning, organizing, controlling, and improving the quality and reliability functions of an organization. The approach taken is to study the management of quality and reliability through the product life cycle, i.e., from research and development, through testing and analysis. The implementation of the managerial and mathematical techniques will be achieved through the study of selected case studies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): STAT 5004
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:

Performance and Productivity Measurement and Evaluation

This course presents the principles and techniques of performance management at the organizational level. Emphasis is placed on the measurement of performance with a focus on productivity measurement, as well as on performance evaluation and how these areas facilitate performance planning, control and improvement. Each student will be required to complete a project which will emphasize the application of these techniques to an organizational setting.
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 are presented. Functional activities and interrelationships are defined for each type of manufacturing model. Typical objectives and operating constraints are identified for functional activities, particularly production planning/control, materials management, facilities design/material handling, manufacturing engineering, quality control, and personnel 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):

ISE 5244:

Facilities Planning and Material Handling

Application of decision theory and operations research techniques in development of mathematical models to specific study areas of facilities planning and material handling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ISE 2404, ISE 3414

Corequisite(s):

ISE 5264:

Modeling and Analysis of Semiconductor Manufacturing

This course will present the modeling and analytical concepts and techniques used for the operational control of a semiconductor manufacturing facility. This will include the following: introduction to wafer fabrication, distinct features of a wafer fab, modeling techniques, planning and operational control problems in a wafer fab, lot sizing, and assembly test and packaging.

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:

Industrial Applications of Robotics Devices

Technical aspects of robotics devices and automation islands employed by the industry are discussed in detail. On-line job teaching and off-line job planning for the industrial robot are compared. Various industrial applications including spray painting, welding, machine loading, and assembly are studied.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): ISE 4264

Corequisite(s):

ISE 5405:

Optimization

5405: Linear programming, modeling, assumptions, and structural properties; primal, dual, and primal-dual simplex algorithms; convergence and implementation issues; duality theory; sensitivity and parametric analysis; linear multiobjective and goal programming, introduction to integer, dynamic, and nonlinear programming. 5406: Nonlinear programming theory and algorithms: convex sets and functions, generalized convexity; and theorems of the alternative, constraint qualifications, necessary, and/or sufficient optimality conditions. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ISE 5406:

Optimization

5405: Linear programming, modeling, assumptions, and structural properties; primal, dual, and primal-dual simplex algorithms; convergence and implementation issues; duality theory; sensitivity and parametric analysis; linear multiobjective and goal programming, introduction to integer, dynamic, and nonlinear programming. 5406: Nonlinear programming theory and algorithms: convex sets and functions, generalized convexity; and theorems of the alternative, constraint qualifications, necessary, and/or sufficient optimality conditions. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): STAT 4105

Corequisite(s):

ISE 5424:

Simulation I

Introduction to discrete event digital simulation, including development of simulation models, random number and random variable generation, model validation and testing, analysis of model output, and an overview of simulation languages. Emphasizes the use of simulation modeling in decision-making through a series of projects involving decision problems. Knowledge of programming required.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): ISE 5034 OR STAT 5104

Corequisite(s):

ISE 5434:

Economic Evaluation of Industrial Projects

Application of engineering economy to the economic evaluation of industrial projects. In general, these projects will include investment in the new facilities as well as replacement of old facilities. Concepts of wealth maximization, utility, and risk will be discussed. Financing will be treated as an integral part of the investment problem.

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 the mathematical analysis of various aspects of production planning and control. Among others, this includes topics in inventory control, forecasting, aggregate production planning, production and project scheduling, and line balancing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): STAT 5104, STAT 5114

Corequisite(s):

ISE 5604:

Human Information Processing

An examination of human information reception, information processing, and skilled performance capabilities and limitations in human-machine systems with an emphasis on models and techniques, including psychophysics, signal detection theory, information theory, supervisory control, and decision theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ISE 5605:

Human Factors System Design

Human factors input into operator-system design, development, testing, and evaluation. Emphasis on the systems approach to human-machine interfacing, with discussion and application of specific methodologies and analytical techniques. Display and control design and selection fundamentals with engineering modeling of manual control systems. In 5606, each student performs a design project relying on application of systems analysis and design techniques. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s): null null

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ISE 5615:

Human Factors Research Design

Procedures for conducting and analyzing human factors and ergonomics experiments, including fundamentals of research, design alternatives, fitting and testing stastical models, and data interpretation and presentation. Primary focus on linear regression (simple and multiple) and analysis of variance (single and multiple factor). Second course in the sequence addresses advanced topics in the theory and application of experimental design and statistical analysis in human factors and ergonomics. Graduate standing required. 5615: I; 5616: II.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): ISE 3614

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

Instruction Type(s): Lecture

Prerequisite(s): ISE 4644, (STAT 3604 OR STAT 4105)

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ISE 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ISE 5974:

Independent Study

NONE

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

NONE

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

NONE

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

Instruction Type(s): 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): null null

Corequisite(s):

ISE 6054:

Decision Theory

Principles, models, and methods of decision theory. Focus on normative decision theory (how rational agents make decisions), prescriptive aspects (helping people make better decisions) and descriptive aspects (how people actually make decisions) including utility theory, decision analysis, risk modeling, game theory, multiscale decision theory, analytical hierarchy process, Bayesian networks, and real options theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ISE 5024

Corequisite(s):

ISE 6284:

Advanced Topics in Manufacturing Systems Engineering

A research-oriented course reviewing the topics and scientific literature in manufacturing systems analysis, design, and control. State-of-the-art topics may include: manufacturing systems design and control, facility

logistics, production planning and scheduling, inventory control, manufacturing systems modeling, and materials management. May be repeated with different content for a maximum of 9 credits.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):   ISE 5204, ISE 5405, ISE 5424
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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s):   ISE 5405
Corequisite(s):

ISE 6424:

Dynamic Programming

Introduction to the theory, applications, and computational aspects of dynamic programming. Markovian decision processes.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):   ISE 5405, ISE 5414
Corequisite(s):

ISE 6434:

Scheduling and Sequence Theory

Theory of deterministic scheduling; sequencing of jobs on a single processor; multi-processor problems including flow shop and job shop scheduling; and introduction to the complexity of computations.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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 develoments 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
Instruction Type(s): 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
Instruction Type(s): 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

Introduction to advanced methods of analysis of simulation model output. Particular emphasis is placed upon the relationship between the decision process and model output. Topics include impact of non-normality, dependence, and transient behavior on model output; methods for identifying near steady-state behavior, batch means, sequential systematic sampling, regeneration method, and determination of simulation run length.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): (ISE 5034 OR STAT 5104), (ISE 5414 OR STAT 5434)

Corequisite(s):

ISE 6514:

Advanced Topics in Mathematical Programming

Decomposition algorithms for large scale linear and nonlinear programs having special structures; algorithmic maps and convergence analysis; optimality conditions and duality in nonlinear programming; polynomial algorithms for linear programming problems; optimization theory and algorithms for nonsmooth and nonconvex nonlinear programs; calculus of variations and optimal control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ISE 5406

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

Instruction Type(s): Lecture

Prerequisite(s): ISE 5604, ISE 5605

Corequisite(s):

ISE 6614:

Human Computer Systems

A survey of human factors procedures used in the design of computer-based systems. Consideration is given to the iterative interface design process, hardware interface design, software interface design, and workplace design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ISE 5605

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

Instruction Type(s): Lecture

Prerequisite(s): ISE 5605

Corequisite(s):

ISE 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MATERIALS SCIENCE AND ENGINEERING

David Clark, Head

Professors: David Clark; Diana Farkas; Robert Hendricks; Peizhen Lu; Guo Quan Lu; Mitsuhiro Murayama; Gary Pickrell; William Reynolds; Dwight Viehland;

Associate Professors: Alexander Aning; Levon Asryan; Sean Corcoran; Earl Foster; Louis Guido; Abby Whittington;

Assistant Professors: Xianming Bai; Carolina Tallon Galdeano; Hang Yu;

Research Faculty: Jie-Fang Li;

Adjunct Professors: M Julian; Stephen Kampe; Michael Kelley; Kathryn Logan;

Affiliated Faculty: Romesh Batra; Michael Bortner; Scott Case; Rafael Davalos; James Heflin; Jerry Hunter; Blake Johnson; Herve Marand; Robert Moore; Khai Ngo; Mark Van Dyke; Christopher Williams; Roe Yoon;

Clifton C. Garvin Professor: Romesh Batra;

Graduate Contact: grandska@vt.edu

Graduate Site: https://mse.vt.edu/

Application Instructions: https://mse.vt.edu/Programs/mse-graduate-program/graduate-admissions.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. 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

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 5014 (CHE 5014) (CHEM 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): , MSE 5165

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

Instruction Type(s): 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

Instruction Type(s): 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 micrscopy. 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MSE 5134:

Introduction to Transmission Electron Microsocpy

Introduction to physical science/inorganic materials oriented transmission electron microscopy and spectroscopy for student pursuing nanoscale characterization in materials science and related fields. Overview of instrumentation and the working principles of transmission and scanning electron microscopes, introductory theories of electron diffraction, imaging and energy dispersive X-ray spectroscopy. Perform electron microscopy image and spectroscopy data interpretation via hands-on laboratory exercises. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

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. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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. Pre-requisite: 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): MSE 5034, MSE 5054
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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

MSE 5314:

Materials Characterization Techniques

Fundamentals, instrumentation and practical application of characterization techniques. Scanning electron microscopy, energy

dispersive x-ray spectrometry, x-ray photoelectron spectrometry, Auger electron spectrometry, Rutherford backscatter spectrometry, focused ion beam tools, scanned probe microscopy, secondary ion mass spectrometry. Training in practical aspects of theory and operation of materials characterization equipment. Pre: Graduate standing.
Credit Hour(s): 4
Lecture Hour(s): 3
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

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): 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. (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):

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
Instruction Type(s): 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 substrstes. 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
Instruction Type(s): Lecture
Prerequisite(s): MSE 5054
Corequisite(s):

MSE 5904:

Project and Report

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):

Corequisite(s):

MSE 5974:

Independent Study

NONE

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

NONE

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

NONE

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

Instruction Type(s): Lecture

Prerequisite(s): MSE 5200

Corequisite(s):

MSE 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

MECHANICAL ENGINEERING

Azim Eskandarian, Head

Emeriti Faculty: James Mahan;

Professors: Mehdi Ahmadian; Thomas Diller; Christopher Fuller; Tomonari Furukawa; Alireza Haghighat; Andrew Kurdila; Douglas Nelson; Wing Fai Ng; Walter O'Brien; Robert Parker; Mark Paul; Michael Roan; Danesh Tafti; Saied Taheri; Jinsuo Zhang; Michael von Spakovsky;

Associate Professors: Bahareh Behkam; Pinhas Ben-Tzvi; Jan Helge Bohn; Jiangtao Cheng; Clinton Dancey; Michael Ellis; John Ferris; Scott Huxtable; Mary Kasarda; Amrinder Nain; Shivakumar Ranganathan; Steve Southward; Brian Vick; Robert West; Alfred Wicks;

Assistant Professors: Pinar Acar; Alan Asbeck; Ling Li; Zheng Li; Yang Liu; Joseph Meadows; Reza Mirzaeifar; Xiaoyu Zheng;

Research Faculty: Ronald Kennedy;

Affiliated Faculty: Masoud Agah; Diana Bairaktarova; Romesh Batra; Brenda Brand; Stefano Brizzolara; Guohua Cao; Scott Case; Rafael Davalos; Raffaella De Vita; William Devenport; Hampton Gabler; Sunghwan Jung; Kevin Lowe; John Robertson; Shane Ross; Joseph Schetz; Gary Seidel; John Socha; Mark Stremler; Costin Untaroiu; Alexandrina Untaroiu; Mark Van Dyke; Scott Verbridge; Craig Woolsey;

Dan Pletta Professor: Mehdi Ahmadian;

Samuel Langley Distinguished Professor of Engineering: Christopher Fuller;

Samuel Herrick Professor:

W. Martin Johnson Professor: Andrew Kurdila;

Christopher C. Kraft Endowed Professor: Wing Fai Ng;

J. Bernard Jones Professor: Walter O'Brien;

Associate Professor of Practice: Mark Pierson;

William S. Cross Professor: Danesh Tafti;

Clifton C. Garvin Professor: Romesh Batra;

L.S. Randolph Professor: Robert Parker;

L. Preston Wade Professor: Rafael Davalos;

Reynolds Metals Professor: Scott Case;

Virginia Microelectronics Consortium Professor: Masoud Agah;

Fred D. Durham Endowed Chair Professor: Joseph Schetz;

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Graduate Chair: csandu@vt.edu

Graduate Academic Advisor: abentzvi@vt.edu

ME Department Site: http://www.me.vt.edu

ME Graduate Studies Guide: http://me-vt.com/wp-content/uploads/2016/09/2016-2017_MEDept_GraduateProgramsPolicy_Sept16_16.pdf

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

Fellowships and Scholarships: http://graduateschool.vt.edu/funding/scholarships-and-fellowships.html

Dates & Deadlines: http://registrar.vt.edu/dates-deadlines-accordion.html

College of Engineering: http://www.eng.vt.edu/

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://veterans.vt.edu/contactus.html

Historical Timetable of Classes: https://banweb.banner.vt.edu/ssb/prod/HZSKVTSC.P_DispHistorical

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 department in mathematics, statistics, and many other disciplines. The Mechanical Engineering Department also has international collaborations with the Technische Universität Darmstadt, as well as the 3+2 program with Shandong University in China. 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 25 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. 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 MMAM.

Nuclear Materials and Fuel Cycle Center

Director: Prof. Jinsuo ZhangThe 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).

Acoustics Signal Processing and Immersive Reality Laboratory

Director: Prof. RoanAcoustics Signal Processing and Immersive Reality Lab (ASPIRe) mission is to explore all aspects of immersive reality. Recent innovations such as Occulus Rift have made tremendous strides toward bringing the visual component of immersion to a wide audience. A major part of our work is making realistic 3D audio for gaming, live performance, distance learning, and cinema a reality.Other major thrusts include development of signal processing algorithms for anomaly detection applied to mechanical systems. Previous work of the lab includes automated bearing fault detection, detection of anomalies in synthetic aperture radar, and automated detection of faulty parts on high-speed assembly lines.We are dedicated to creating an environment of inclusion, where everyone's voice is heard and ideas flow freely. The main goal of the lab is to provide students with an extensive toolbox of highly-desired skills, high-impact publications, specialized technical experience and to have a lot of fun doing it!

Advanced Manufacturing and Metamaterials Laboratory

Director: Prof. Rayne ZhengThe Advanced Manufacturing and Metamaterials Laboratory (AMML) focuses on research and development of novel, transformative additive manufacturing (3D printing) processes and micro/nanoscale fabrication technologies capable of three-dimensional material and systems by design for applications ranging from energy, structures to healthcare.

Advanced Materials And Technologies Laboratory

Director: Prof. 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 Power and Propulsion Laboratory

Director: Prof. EkkadAdvanced 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. HerdmanAdvanced 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.

Advanced Vehicle Dynamics Laboratory

Director: Prof. Sandu The Advanced Vehicle Dynamics Laboratory (AVDL) conducts innovative research and product development in advanced vehicle technologies toward improving the sponsors' products and market share, and provides a productive environment for educating both graduate and undergraduate students to better serve their future employers.

Applied Autonomy and Mechatronics Research Laboratory

Director: Prof. WicksThe Applied Autonomy and Mechatronics Research Laboratory focuses on creating practical engineering solutions by integrating sensors and microcontrollers in to military and medical applications.

Assistive Robotics Laboratory

Director: Prof. AsbeckThe Assistive Robotics Laboratory (ARLab) 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. 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.

Bio-Inspired Materials and Devices Laboratory

Director: Prof. PriyaThe Bio-Inspired Materials and Devices laboratory (BMDL) focuses on understanding of the natures design principles and translating the understanding into artificial systems. Current programs in the lab cover jellyfish locomotion, millipede-inspired sensor nodes, artificial photosynthesis, and multi-jet swimmers.

Bio-inspired Fluid Laboratory

Director: Prof. Sunny JungThe Bio-inspired Fluid Laboratory's research interest is to investigate fluid problems emerging from the interaction of deformable biological objects with surrounding fluids. Research efforts are dedicated to understanding how biological systems interact, harness, and cope with fluidic surroundings. The Bio-Inspired Fluid lab will continue to explore the dynamics of interaction among biological and fluid interfaces through a combined theoretical and experimental approach.

Center for Bio-inspired Science & Technology

Director: Prof. 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.

Center for Dynamic Systems Modeling and Control

Director: Prof. LeonessaCenter for Dynamic Systems Modeling and Control (DySMAC) research aims to develop a model-free controller for unknown systems. It incorporates state?of-the?art algorithms and computationally efficient parallel processing to develop a 'curved regular grid' of terrain surface data.

Center for Energy Harvesting Materials and Systems

Director: Prof. HajjThe Center for Energy Harvesting Materials and Systems (CEHMS) conducts applied and fundamental research in energy harvesting and sensing covering wide range of mechanisms such as piezoelectrics, electromagnetics, thermoelectrics, photovoltaics, batteries, windmills shape memory and thermomagnetics.

Center for Energy Systems Research

Director: Prof. 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. 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 Intelligent Material Systems and Structures

Director: Prof. KasardaThe Center for Intelligent Material Systems and Structures (CIMSS) focuses on the design and modeling of actuators and damping devices, as well as infrastructure health monitoring and diagnostics using structures and active materials.

Center for Tire Research

Director: Prof. 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

Director: Prof. WoolseyThe Center for Unmanned Aircraft Systems (C-UAS) was established in 2012 and is an Industry/University Cooperative Research Center involving Brigham Young University, the University of Colorado at Boulder, Virginia Tech, Georgia Institute of Technology 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. AhmadianCenter for Vehicle Systems and Safety (CVeSS) is engaged in a wide variety of research ranging from advanced vehicle suspensions, to measurement and modeling of terrain and terramechanics, to biodynamics, to dynamic control of vehicle systems, to vehicle stability and rollover analysis.

Computational Multiphysics Systems Laboratory

Director: Prof. FurukawaThe Computational Multiphysics Systems Laboratory is one of the world's two computational multiphysics systems laboratories. Our group linvestigates the analysis and synthesis of computational multiphysics systems which range from deformable bodies studied in computational and experimental mechanics to rigid bodies studied in robotics.

Design, Research & Education of Additive Manufacturing Systems Laboratory

Director: Prof. WilliamsThe research mission of the Design, Research & Education of Additive Manufacturing Systems Laboratory (DREAMS) is to be a leader in the transition of rapid prototyping technologies to the new paradigm of additive manufacturing.

Dynamics and Vibration Laboratory

Director: Prof. ParkerThe Dynamics and Vibration Lab directed by Prof. R. G. Parker applies analytical methods, advanced computational tools, and experimental measurements to explore the vibration of mechanical systems, with special interest in high-speed rotating or translating systems. We look for practically important problems whose solution calls for advanced modeling and/or analysis, that is, problems that sit at the interface of fundamental academic research and engineering applications. Topics where the lab has been especially active include aircraft engines, helicopters, automotive systems, geared transmissions, cyclically symmetric systems, centrifugal pendulum vibration absorbers, high-speed moving media, and efficient computational algorithms.

Energy Harvesting and Mechatronics Research Laboratory

Director: Prof. ZuoThe Energy Harvesting and Mechatronics Research Lab conducts applied and fundamental research in energy harvesting, vibration control, mechatronics design, thermoelectric materials, vehicle dynamics, smart structures, and advanced sensors.

Heat Transfer Measurements Laboratory

Director: Prof. DillerThe Heat Transfer Measurements Lab (HTML) performs heat transfer measurements across different length scales: nano, micro, and macro. Facilities include time-domain thermoreflectance equipment to measure nano to microscale heat conduction, thermoelectric measurement systems, heat flux calibration systems for convection, conduction, and radiation modes, as well as heat flux sensor fabrication equipment.

High Performance Computational Fluid Thermal Science and Engineering Group

Director: Prof. TaftiThe High Performance Computational Fluid Thermal Science and Engineering Group focuses on research in the advancement and application of computational methods and tools to aid the physical understanding of complex engineering, biological, and bioinspired fluid-thermal flows.

Intelligent Transportation Laboratory

Director: Prof. 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 Advanced Multifunctional Materials and Thermal Engineering

Director: Prof. MahajanThe laboratory hosts a prototype facility for fabrication on non-woven nanofibers, and a facility for nanocoatings using graphene, graphene oxide and carbon nanotubes.

Laboratory of Transport Phenomena for Advanced Technologies

Director: Prof. QiaoThe Laboratory of Transport Phenomena for Advanced Technologies focuses on quantum, atomistic, mesoscopic, and multiscale 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 electrical energy storage, thermal management, biomanufacturing, and lab-on-chip.

Li Energy Storage Systems Laboratory

Director: Prof. Zheng LiLi Energy Storage Systems (LESS) lab focuses on the design and development of energy storage materials, systems and their manufacturing process that provide technically and economically viable energy storage solutions for electric transportation and power grids.

Micro/NanoScale Biotic/Abiotic Systems Engineering Laboratory

Director: Prof. 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 can be divided into two broad categories: (1) Developing bio-hybrid engineered 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 nanotopography on fungal biofilm formation). We utilize 2D and 3D microfluidic platforms to establish well-defined and repeatable test environments for most of our projects.

Multi-Phase Flow Laboratory

Director: Prof. LiuThe Multi-Phase Flow 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.

Nonlinear Sytems Laboratory

Director: Prof. WoolseyThe Nonlinear Sytems 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. Woolsey. The NSL is a Core Laboratory in the Virginia Center for Autonomous Systems (VaCAS).

Nuclear Science and Engineering Laboratory

Director: Prof. 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.

Occupational Ergonomics and Biomechanics Laboratory

Director: Prof. NussbaumThe Occupational Ergonomics and Biomechanics Laboratory (OEB) conducts work in theoretical and applied ergonomics, occupational biomechanics, and work physiology, primarily relating to worksite, workstation, and equipment evaluation and design. Research in the lab addresses: 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. Two primary areas of emphasis are the prevention of musculoskeletal disorders and slip/trip/fall accidents.

Performance Engineering Research Laboratory

Director: Prof. 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.

Radiation Measurement, Simulation and Visualization Laboratory

Directors: Prof. Haghighat & PiersonThe Radiation Measurement, Simulation and Visualization Laboratory (RMSVL) supports research activities in radiation detection and materials, radiation dosimetry, light-weight radiation shielding materials, radiation detection arrays, medical physics, nuclear safeguards, design of passive and active interrogation systems, benchmarking of particle transport codes and radiation transport visualization. In addition, it provides modeling, simulation and visualization 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

Railway Technologies Laboratory

Director: Prof. AhmadianThe Railway Technologies Laboratory's mission is to explore and help implement technologies that will enable the U.S. railroad companies to become more efficient and competitive in their day-to-day operation.

Robotics and Mechatronics Laboratory

Director: Prof. Ben-TzviThe Robotics and Mechatronics Laboratory's mission is to conduct advanced fundamental and applied research in robotics, intelligent autonomous systems, mechatronics, human-robot interactions, 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 & reconfigurable mobile robotics for search & rescue and hazardous environment sensing and monitoring; design of intelligent biomimetic robotic tails for robust dynamic stabilization and agile maneuvering of legged robots on rough terrain; autonomous unmanned aerial vehicle (UAV) launch and recovery from naval vessels; haptics devices and upper-extremity exoskeletons for tele-operation and rehabilitation therapy; advanced medical devices and robotic systems for precision surgery; and novel smart sensors and actuators for biomedical applications.

SBES Advanced MultiScale CT Laboratory

Director: Prof. Ge WangSBES Advanced MultiScale CT Laboratory has an x-ray tomosynthesis system Selenia was acquired under a collaborative agreement with Hologic and installed for clinical imaging. Selenia uses selenium-based direct capture to eliminate light diffusion, a 24x29cm detector to cover the whole breast in a single view, and a HTC grid technology to reduceradiation scatter. For pre-clinical imaging, a true-color micro-CT scanner MARS was acquired under a research agreement with MARS Bioimaging Ltd . Also, there are an x-ray imaging platform, a Scanco micro-CT scanner, an Xradia micro-CT scanner and an Xradia nano-CT scanner in our division, which cover six orders of magnitude in terms of image resolution and sample size. The Scanco system has a field of view (FOV) of 20-38mm with a best resolution of 16µm at 10% MTF. The Xradia micro-CT system is the highest resolution micro-CT system on the market, which can achieve 0.5µm resolution at 10% MTF, and handle samples of up to 100mm in diameter. In collaboration with Xradia, SBES acquired a 50nm resolution nano-CT system. We are developing ROI-focusing and interior reconstruction capabilities for this system. This next-generation nano-CT system will allow us to accommodate specimens much larger than that the current nano-CT protocols permit. Because of the high-resolution performance of the micro-/nano-CT systems, the nature of the housing is vital to ensuring their technical development and biomedical applications. Our Lab has one dedicated space for these systems in the ICTAS-CRC Building A, adjacent to the Nanoscale Characterization and Fabrication Laboratory (NCFL).

Spinneret based Tunable Engineered Parameters Laboratory

Director: Prof. 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.

Thermal Radiation Group

Director: Prof. MahanThe Thermal Radiation Group conducts fundamental and applied research in optical and thermal radiation phenomena with applications in the fields of Earth radiation budget monitoring, infrared low observables, calibration, and related instrumentation.

Turbomachinery and Propulsion Laboratory

Director: Prof. O'BrienThe mission of the Virginia Tech Turbomachinery and Propulsion Research Laboratory is to support and facilitate advanced research in turbomachinery, gas turbines, and related modeling and diagnostics. The goals of the laboratory include providing laboratory facilities and an environment for collaboration of faculty, students, and researchers on turbomachinery and gas turbine research. Educating students for research and development in turbomachinery and related fields. Generating funding to support the research and publication of research results. Presenting research results to the turbomachinery research community at conferences and meetings and enhancing the reputation of the laboratory and Virginia Tech as a leader in turbomachinery and propulsion research.

Unmanned Systems Laboratory

Director: Prof. 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.

Vehicle Terrain Performance Laboratory

Director: Prof. FerrisThe mission of the Vehicle Terrain Performance Lab (VTPL) is to improve vehicle system performance by studying the interactions between vehicles and terrain.

Vibrations & Acoustics Laboratory

Director: Prof. 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.

Vibrations, Adaptive Structures and Testing Laboratory

Director: Prof. Tarazaga Vibrations, Adaptive Structures and Testing Laboratory (VAST) studies the dynamic behavior of structures from very large inflatable satellites (Gossamer Structures) to micron size stereocilia. Adaptive Structures research relates to structures that have the ability to adapt, evolve or change their properties or behaviour in response to the environment around them" (taken from Adaptive Structures: Engineering Applications).

Virginia Tech Microelectromechanical Systems Laboratory

Director: Prof. 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.

Virginia Tech Smart Infrastructure Laboratory

Director: Prof. TarazagaThe Virginia Tech Smart Infrastructure Laboratory (VTSIL) works to advance research and education in topics that utilize sensor information to improve the design, monitoring and daily operation of civil and mechanical infrastructure as well as to investigate how humans interact with the built environment.

Visionarium

Director: Prof. HerdmanVisionarium for virtual 3-D visualization was built in June 2010, the VisBox VisCube(TM) is the replacement to the old CAVE. Like the CAVE before it, the VisCube has three rear-projected ten foot square walls and a top-projected floor with a cutout hiding a MOOG motion platform. The VisCube features numerous hardware and software upgrades to increase the fidelity of the visualization (more pixels (1920×1920 per wall), more brightness, more contrast) as well as the ease of use for the researcher (wireless tracking).

Wendy and Norris E. Mitchell '58 Robotics Laboratory

Director: Prof. Furukawa & LeonessaThe Wendy and Norris E. Mitchell '58 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.

X-ray Systems Laboratory

Director: Prof. Guohua CaoThe X-ray Systems Laboratory houses two micro-CT systems. One is a carbon-nanotube based dynamic micro-CT scanner (DynaTom). This micro-CT scanner is one of the world's best in 4D micro-CT imaging of small-animal models with high spatial and temporal resolution and minimum radiation dose. Another is a bench-top micro-CT platform (Xplorer) for early proof-of-concept development of novel imaging technologies. Overall, the X-ray Systems Laboratory focuses on the system engineering of next-generation CT systems through novel x-ray sources, detectors, and algorithms. The lab has the following resources: two x-ray shielding rooms of 12' by 9' dimension each and rated for up to 80kVp two optical tables one Pfeiffer HI CUBE vacuum pump station a custom-built CNT field emission measurement station one chemical hood for electro-polishing vacuum parts several workbenches for electrical and mechanical assembling several motorized electromechanical devices including 1 goniometer, 3 linear stages and 2 rotation stages four Dell PC's for CAD design, numerical simulations, data acquisition and equipment control. Machine shop services are readily available on VT campus.

ZT Group

Director: Prof. TianThe ZT Group focuses on understanding and engineering nanoscale thermal transport in hard and soft materials for energy applications and beyond. We use a combination of atomistic simulations and ultrafast laser based measurements.

DEGREES OFFERED

MEng Degree

Offered In (Hampton Roads, Blacksburg, National Capital Region)

TOEFL

iBT: (105.0)

GRE

General Test: Analytical Writing (4.5), Verbal (150.0), Quantitative (165.0)

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 application instructions 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. Masters' students must complete a minimum of 30 semester hours of graduate study beyond the baccalaureate. Because the MENG requires more coursework hours (24) and only project hours (6), departmental funding is not available. MENG students must submit a Plan of Study to the Graduate Coordinator before completing the first semester registered as a MENG student. The Master of Engineering Degree in Mechanical Engineering must include the following minimum requirements: 1. Engineering project and report (ME 5904): 6 hours minimum2. Approved coursework meeting the following: 24 hours minimum Courses numbered 5000, or higher: 18 hours minimum ME Course Work: 9 hours minimum Courses outside the student's discipline area: 6 hours minimum ME approved Mathematics or Statistics: 3 hours minimum A maximum of two Virginia Tech 4000 level courses can be used 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 allowed. Transfer courses meeting Graduate School policies, may be listed and approved on the Plan of Study. Seminar Program: All Blacksburg students must participate in the Mechanical Engineering program seminar series each semester.Ethics: Beginning Fall 2014, all graduate students must meet the Graduate School's Ethics requirement by completing GRAD 5014 Academic Integrity & Plagiarism within their first 2 semesters. A written Project & Report must be submitted for the Final Defense. No courses below the 4000 level will be accepted for graduate credit. Contact the ME graduate program for approval procedures before taking any Special (5984 only) or Independent Study (5974 only) courses.

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)

PhD Degree

Offered In (Hampton Roads, Blacksburg, National Capital Region)

TOEFL

iBT: (105.0)

GRE

General Test: Analytical Writing (4.5), Verbal (150.0), Quantitative (165.0)

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 that leads to research methodology from concept to completion. Students will be able to present their research as the leading expert in that 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 application instructions web page. Doctor of Philosophy (PhD) Degree Requirements The Doctor of Philosophy (PhD) in Mechanical Engineering requires that doctoral students must complete a minimum of 90 semester hours of graduate study (with stipulations listed below) beyond the baccalaureate, pass a qualifying exam, preliminary exam, and complete a research dissertation. PhD students must submit a Plan of Study before completing the second semester registered as a PhD student. Much of the course work from the Masters degree can be used towards the PhD. The Plan of Study must meet the following minimum requirements: Research & Dissertation (7994): 30 hours minimum Approved Graduate Courses: 30 hours minimum Additional hours of either research (7994) or coursework: 30 hours minimum Courses numbered 5000, or higher: 27 hours minimum ME approved Mathematics or Statistics: 3 hours post baccalaureate For continuously enrolled VT students completing an MS, most or all coursework can be used towards the PhD Transfer courses (including from a non-VT MS degree) meeting Graduate School policies, may be listed and approved on the Plan of Study. Independent/Special Study Courses (5974 and 5984): 12 hours maximum Once course requirements in number 2 above are met, students may take a maximum of two Virginia Tech 4000 level courses. These courses should be on the Technical Elective List for undergraduate ME students. If it is a conjoint course, it must be taken at the 5000 level. Seminar Program: All Blacksburg students must participate in the Mechanical Engineering program seminar series each semester.Ethics: Beginning Fall 2014, all graduate students must meet the Graduate School's Ethics requirement by completing GRAD 5014 Academic Integrity & Plagiarism within their first 2 semesters. No courses below the 4000 level will be accepted for graduate credit. Contact the ME graduate program for approval procedures before taking any Special (5984 only) or Independent Study (5974 only) courses. In addition, doctoral students matriculating with an MS degree 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 must be submitted for the Final Defense. Direct PhD MS Students may enroll as a "Direct-PhD" upon passing the PhD Qualifying exam within their first 4 semesters and securing a PhD Advisor. All PhD requirements are the same as listed above.

Degree Concentrations:

Biomedical Engineering

Mechanical Engineering graduate students may earn a Biomedical Engineering Option through the VT-WFU School of Biomedical Engineering & Sciences while pursuing an advanced degree. Upon completion of certain requirements the option is placed on the student's transcript when the degree is conferred. For option requirements please refer to the SBES web page: www.sbes.vt.edu.

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 (Hampton Roads, Blacksburg, National Capital Region)

TOEFL

iBT: (105.0)

GRE

General: Verbal (150.0), Quantitative (165.0), Analytical (4.5)

IELTS

English Proficiency: (7.0)

The MS program seeks to prepare graduate students by providing them with practical and theoretical engineering knowledge, training the students to be able to become technical leaders, design a research methodology that solves an existing engineering problem, to present on their research, and to contribute to the scholarly work of the global mechanical engineering 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 application instructions web page. Master of Science (MS) Degree Requirements The Master of Science (MS) in Mechanical Engineering requires that masters' students complete a minimum of 30 semester hours of graduate study beyond the baccalaureate, and complete a research thesis. MS students must submit a Plan of Study before completing the first semester registered as a MS student. 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 can be used. 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 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 can be used 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 allowed. Transfer courses meeting Graduate School policies, may be listed and approved on the Plan of Study. Seminar Program: All Blacksburg students must participate in the Mechanical Engineering program seminar series each semester.Ethics: Beginning Fall 2014, all graduate students must meet the Graduate School's Ethics requirement by completing GRAD 5014 Academic Integrity & Plagiarism within their first 2 semesters.   No courses below the 4000 level will be accepted for graduate credit.

Degree Concentrations:

Biomedical Engineering

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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 5034:

Bio-Inspired Technology

Introduction to engineering solutions inspiried by the functional mechanisms of biological systems. An overview of bio-inspired technology and the state of the art. Expolarion 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. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 5135 (AOE 5135):

Vehicle Propulsion

Aerothermodynamics of gas turbines and rockets: cycle analysis of turbojets, turbofans, prop fans, and turbo props. Analysis of ramjets and scramjets. Performance of inlets, combustors, and nozzles. Elementary theory of turbomachinery. Liquid and solid propellant chemical rockets. Electrostatic, electromagnetic, and electrothermal propulsion. Integrated rocket-ramjet. Fuels and propulsion systems for future transportation system.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): null null

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 emcompasses 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

Instruction Type(s): 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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

ME 5254:

Fuel Cell Systems

Fuel cell systems for transportation, buildings, utility and portable power energy conversion applications. Overview of fuel cell technology. Thermodynamics of direct energy conversion and fuel cell efficiency. Electrochemistry, equilibrium and reaction kinetics. Temperature and pressure effects on polarization curves. Proton exchange membrane fuel cell performance modeling. Fuel cell system components: heat exchangers, humidifiers, air compressors, electric power processing and management. Overall system integration, modeling, and control. Fuel cells for transportation, vehicle performance and efficiency characteristics. Fuel processing and reformers. Fuel cell system design, economics, and optimization. Graduate standing in Engineering required. 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 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

Instruction Type(s): Lecture

Prerequisite(s): null null

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 5334:

Energy Systems: Theory and Applications

Theory and applications of thermodynamic and fluid mechanics principles as applied to energy systems. Fundamental concepts on exergy, mixtures, psychrometry and thermochemistry. Analyses and appplications include vapor and gas power systems, refrigeration, air conditioning, combustion processes and one-dimensional compressible flow. Pre: Graduate Standing.

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 donduction, convection, diffusion, generation/ consumption. Application of analytical and computational methods to solve differential equations that describe unsteady an/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 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

ME 5434:

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 uncerainty 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 5504:

Introduction to Rotor Dynamics Analysis

Theory and application of dynamics, vibrations, fluid mechanics, and tribology to the design of rotating machinery. Course content covers material from single mass rotor analysis up to multi-mass rotor system analysis. System critical speeds, forced response, and dynamic stability are discussed. Hydrodynamic bearings, liquid seals, and gas labyrinth seals are presented as necessary elements for rotor design analysis. Field balancing by single plane, two plane and multi plane methods are presented. Experimental in-class work on single and two- plane methods. Industry standards are discussed. State of the art PC computer analysis tools are provided for the student to use in course for optimum rotor design analysis. One computer analysis program will be written by the student in a language or math package of their choice. A formal presentation of a course project will be given at the end of semester by each student enrolled for credit. Even Years. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): ME 3504, ME 4404

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 mulit-sensor data fusion, simultaneous localization and mapping, quantification of belief, Bayesian control. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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 (ECE 5754) (AOE 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 (AOE 5764) (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): ME 5554 OR ME 5544 OR AOE 5744 OR AOE 5754 OR ECE 5744 OR ECE 5754
Corequisite(s):

ME 5574 (ECE 5774) (AOE 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.
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 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 statisitical estimation. Geometric problems. Control and trajectory planning. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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:
Modeling and Simulation of Multibody Dynamic Systems
Develops basic mathematical tools for kinematics and dynamics modeling of planar and spatial rigid multibody dynamic systems. Introduces absolute and relative kinematic constraints and driving constraints. Introduces the virtual work and the generalized force concepts. Derives the equations of motion for constrained rigid multibody systems. Studies the inverse dynamics of kinematically driven systems, equilibruim conditions, and constant reaction forces. Introduces Euler parameters for the orientation of rigid bodies in space. Presents numerical considerations in solving spatial differential-algebraic equations of motion. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ME 5684:

Unified System Dynamics

Bond Graph method as a unified tool for modeling and simulation of complex dynamic systems. Coupled subsystems with mixed energy domains and dynamic coupling between subsystems governed by ordinary and partial differential equations. Pre: Graduate standing.

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

Instruction Type(s): Lecture

Prerequisite(s): ISE 5174

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
Instruction Type(s): 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 acquistion, 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
Instruction Type(s): 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 acqusition, 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
Instruction Type(s): 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, Green's 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ME 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ME 5774:

Introduction to Stochastics

Provide a strong foundation for analyzing stochastic processes and exposure to state-of-the-art techniques. Strengthen existing knowledge of probability and statistics including covariance functions and properties, stationarity and ergodicity, and special density. Introduce stochastic processes and modeling and analysis techniques including Markov Chains, and ARIMA models. 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 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 converson, 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, automoblies and the human body. Pre-requisite: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

NONE

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 5914 (AOE 5914) (ECE 5914):

Autonomous Systems Seminar

Weekly technical presentations from local and visiting scholars on current topics related to the theory, design and development, and application of autonomous vehicle systems. Pre-requisite: Graduate standing required

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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 maximin of 6 credits. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ME 5974:

Independent Study

NONE

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

NONE

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

NONE

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 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:

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 commerical 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 uncertainy through models. Estimation of total prediction uncertainy 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 6544 (AOE 6744) (ECE 6744):
Linear Control Theory
Advanced introduction to the theory of optimal control of time-varying and time-invarient 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) (AOE 6774):
Adaptive Contol 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
Instruction Type(s): 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 itegration 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
Instruction Type(s): Lecture
Prerequisite(s): ME 5404, ME 5744
Corequisite(s):

ME 6984:
Special Study
NONE
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
NONE
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

Erik Westman, Head

Professors: Michael Karmis; Gerald Luttrell; Kramer Luxbacher; Erik Westman; Roe Yoon;
Associate Professors: Mario Karfakis; Christopher Noble; Emily Sarver;
Assistant Professors: Cheng Chen; Ellen Gilliland; Bahareh Nojabaei; Nino Ripepi;
E. Morgan Massey Professor: Gerald Luttrell;
Stonie Barker Professor: Michael Karmis;
University Distinguished Professor and Nicholas T. Camicia Professor: Roe

Yoon;

Research Assistant Professors: Edmund Jong;

Graduate Contact: kraylux@vt.edu

Graduate Contact: mcrotto@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 (MinE) 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, systems analysis, health and safety, mineral and coal processing, applied surface and colloid chemistry, conservation and the environment, mining ventilation, computer modeling/simulation, automation and control, and reservoir/natural gas/shale gas 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 MinE graduate program is administered by the Department Head 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 petition 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, i.e., 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, the National Capital Region Office in Alexandria, 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 5015:

Advanced Mining Engineering

Selected concepts and principles in the discipline including factors in pillar design, contiguous bed mining, and technical problems in deep mining; mineral beneficiation, coal technology, hydrometallurgical, and pyrometallurgical processes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): 4L, Lecture

Instruction Type(s): 4L, Lecture

Prerequisite(s): , MINE 4074

Corequisite(s):

MINE 5016:

Advanced Mining Engeering

Selected concepts and principles in the discipline including factors in pillar design, contiguous bed mining, and technical problems in deep mining; mineral beneficiation, coal technology, hydrometallurgical, and pyrometallurgical processes.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): , MINE 4074

Corequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MINE 5026:

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

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MINE 5046:

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lab, Lecture

Prerequisite(s): , GEOS 4414

Corequisite(s):

MINE 5085:

In Situ Rock Measurements and Monitoring

In situ testing of rocks rationale, in situ rock mass behavior, initial state of stress, stress-strain in polar coordinates, hole in a plate problem, internally pressurized thick walled cylinder problem, in situ rock stress measurement methods, insitu performance monitoring of rock structures, and field instrumentation. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MINE 5104:

Modeling and Monitoring the Behavior of Mining Systems

Advanced numerical modeling and monitoring methods. Emphasis on the use of numerical tools and monitoring methods in understanding the complex behavior of mining systems. Application of these tools to areas such as mineral processing, underground and surface structures, and material flow through independent project work. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MINE 5904:

Project and Report

NONE

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MINE 5974:

Independent Study

NONE

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

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

MINE 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

OCEAN ENGINEERING

Eric Paterson, Head

Professors: Alan Brown; Robert Canfield; William Devenport; Rakesh Kapania; Lin Ma; Eric Paterson; Mark Psiaki; Pradeep Raj; Christopher Roy; Joseph Schetz; Craig Woolsey;

Associate Professors: Jonathan Black; Stefano Brizzolara; Scott England; Mazen Farhood; Kevin Lowe; Mayuresh Patil; Michael Philen; Gary Seidel; Cornel Sultan;

Assistant Professors: Colin Adams; William Alexander; Seongim Choi; Christine Gilbert; Luca Massa; Bhuvana Srinivasan; Kyriakos Vamvoudakis; Kevin Wang; Heng Xiao;

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;

Fred D. Durham Endowed Chair Professor: Joseph Schetz;

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Student Handbook: http://www.aoe.vt.edu/graduate/forms/AOE_Graduate_P-P.pdf

Graduate Site: http://www.aoe.vt.edu/graduate/index.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. In addition, the Aerospace and Ocean Engineering Department participates in the Systems Engineering interdisciplinary program where students take courses across several engineering departments and outside of the College of Engineering. The requirements for this program are set by the Systems Engineering Advisory Committee and are different from those indicated previously.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. 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 aerodynamics, structures and structural dynamics, flight dynamics and control, ocean engineering, multidisciplinary design, applied mathematics, and applied physics. 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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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

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 10 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)[1]. 2. A minimum of 12 credit hours (15 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 (9 for non-thesis) 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. All Ocean Engineering M.S. candidates are required to take: AOE 4404, Applied Numerical Methods; AOE 5074, Advanced Ship Structural Analysis[3]; AOE 5104, Advanced Aero and Hydrodynamics; and AOE 5334, Advanced Ship Dynamics. In addition, thesis (non-thesis) students must take 9 (18) hours of approved electives, and non-thesis students must take 6 units of "Project and Report" or complete a 6 unit Capstone Naval Ship Design Project (AOE 5315 and AOE 5316). Electives for thesis students are determined in consultation with the Advisory Committee Chair. Non-thesis ocean engineering students must take two of the following courses: AOE 4024, An Introduction to the Finite Element Method; AOE 4264, Principles of Naval Engineering; AOE 5034, Mechanical and Structural Vibrations; AOE 5084, Submarine Design; AOE 5144, Boundary Layer Theory and Heat Transfer; AOE 5304, Advanced Naval Architecture; AOE 5305, Marine Engineering; AOE 5314, Naval Ship System Design and Effectiveness[4]; AOE 5374, Rationally-Based Design of Ocean Structures; AOE 5434G, Advanced Introduction to Computational Fluid Dynamics; AOE 5444G, Advanced Dynamics of High-Speed Craft; AOE 5454, Advanced Aerospace and Ocean Engineering Instrumentation; and AOE 6145, Computational Fluid Dynamics. 7. If a student has previously taken any of the required courses listed above or equivalent, while a Virginia Tech undergraduate or a student elsewhere, that course must be replaced with another course approved by the Advisory Committee. A student will not be allowed to repeat a Virginia Tech course (or an equivalent course from another institution) for a grade. A required AOE course can only be replaced with another AOE course. [1] Non-thesis Ocean Engineering M.S. candidates may take both AOE 5315-5316: Naval Ship Design to meet the 6 unit Capstone Naval Ship Design Project in place of 6 units of AOE 5904: Project and Report. [2] It is strongly recommended that students who wish to take AOE 6744, first take AOE 5744, Linear Systems Theory or an equivalent course on linear, time-varying systems. [3] If AOE 4274: Computer-Based Design of Ocean Structures has already been taken, then one of the following two courses must be substituted: AOE 5024: Vehicle Structures or AOE 5374: Rationally-Based Design of Ocean Structures. [4] It is strongly recommended that students who wish to take AOE 5314: Naval Ship System Design and Effectiveness, first take AOE 4264: Principles of Naval Engineering.

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): AOE 5024
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. I
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:
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. 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):

AOE 5074:
Advanced Ship Structural Analysis
Computer modeling of ship structures. Levels and types of structural failures in ships. Elastic and inelastic plate bending. Elastic and inelastic buckling of columns, plates and stiffened panels. Computer programs for ultimate strength analysis of ships. Sample applications. 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): AOE 5024
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.

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)

Corequisite(s):

AOE 5135 (ME 5135):

Vehicle Propulsion

Aerothermodynamics of gas turbines and rockets: cycle analysis of turbojets, turbofans, prop fans, and turbo props. Analysis of ramjets and scramjets. Performance of inlets, combustors, and nozzles. Elementary theory of turbomachinery. Liquid and solid propellant chemical rockets. Electrostatic, electromagnetic, and electrothermal propulsion. Integrated rocket-ramjet. Fuels and propulsion systems for future transportation system.

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), ME 3134 (UG)

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, muliti-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 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 resistivtiy, 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 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): AOE 3134 (UG), AOE 3234 (UG) OR AOE 4140 (UG)

Corequisite(s):

AOE 5234:

Orbital Mechanics

Lagrange's equations of motion, two-body problem, conic sections, Kepler's laws, orbit determination. Multi-body problems and integrals of motion. Fundamentals of perturbation theory, variation of parameters, and Lagrange's 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): AOE 4134 (UG)

Corequisite(s):

AOE 5244:

Optimization Techniques

Ordinary minimum problems with constraints. The classical multiplier method, descent methods, and quasi-Newton methods. Optimal control and the maximum principle. Second-order necessary conditions. Singular control. Continuous gradient methods, conjugate gradients.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): AOE 3134 (UG), MATH 4564 (UG)

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 5305:

Marine Engineering

In depth analysis and design of major ship propulsion system and machinery components. 5305: Propellers, shafting and gearing. Intro. to boilers, steam and gas turbines, nuclear power plants and diesels. 5306: Advanced study of diesels and gas turbines. Internal combustion engines. Shipboard HVAC, pump and motor systems. Cost estimation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): ME 3134 (UG)

Corequisite(s):

AOE 5314:

Naval Ship System Design and Effectiveness

Concepts, theory, and methods for the engineering, design, integration, and assessment of naval ship systems. Modeling of system effectiveness for multidisciplinary and multi-objective design optimization. Mathematical theory for naval effectiveness models (OEMs) and physics-based mechanical, electrical, sensor, control, and weapon systems models to assess total-ship effectivesness in anti-air warfare, target coverage, and fleet air warfare. System integration, interfaces, and analyses considering ship arrangements, electromagnetic compatibility, signatures, system deactivation diagrams, reliabiltiy, maintenance, modularity, system power, shock and weapons effects, fire analysis, damage control, and overal system survivability.

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 5405

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 5305, 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 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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): AOE 3234 (UG), MATH 4564 (UG)
Corequisite(s):

AOE 5374:

Rationally-Based Design of Ocean Structures

Methodology of rationally-based optimum structural design of ships based on explicit calculation of failure loads. Torsion of thin-wall sections. Ultimate limit states of stiffened cylinders. Structural optimization of stiffened panels. Computer programs for ultimate strength analysis and structural design of ships, submarines and offshore platforms. Sample applications.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): AOE 5074 (UG)
Corequisite(s):

AOE 5434G:

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:

Adv Dyn of High-Speed 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 5454:

Advanced Aerospace and Ocean Engineering Instrumentation

An advanced treatment of the principles of measurement systems; standards, accuracy, uncertainty and statistical concepts, and signal processing. Detectors, transducers, and instruments for aerospace and ocean engineering. Hot-wire and laser anemometry. Signal conditioning systems and readout devices, digital data acquisition principles. Electronics and electrical test instruments. Case studies of practical instrumentation systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): AOE 3014 (UG), AOE 3034 (UG)
Corequisite(s):

AOE 5464:

Combustion Chem & Diag

Combustion chemistry and laser-based combustion diagnostics from a fundamental, microscopic level. Statistical thermodynamics, molecular collisional models, chemical kinetics, reaction mechanisms for combustion systems, spectroscopy (absorption, Rayleigh, Raman, and Laser Induced Fluorescence), and diagnostics for measuring various combustion properties. Practical implementation and industrial 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):

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 macroscal 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 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
Instruction Type(s): 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
Instruction Type(s): 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 (ECE 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 (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 pratical 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 (ECE 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.

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 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

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

AOE 5904:

Project and Report

NONE

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 5914 (ECE 5914) (ME 5914):

Autonomous Systems Seminar

Weekly technical presentations from local and visiting scholars on current topics related to the theory, design and development, and application of autonomous vehicle systems. Pre-Requisite: Graduate Standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

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 Master's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

AOE 5974:

Independent Study

NONE

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):

Corequisite(s):

AOE 5984:

Special Study

NONE

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

NONE

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 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

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.

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 5104

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

Instruction Type(s): 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 turbulance, 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 designer's perspective. Structure of the control-oriented equations of motion in relation to robust control design. Bio-inspiried design.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): AOE 5024, AOE 5204

Corequisite(s):

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 commerical CFD packages to select problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 uncertainy through models. Estimation of total prediction uncertainy 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 (ECE 6744) (ME 6544):

Linear Control Theory

Advanced introduction to the theory of optimal control of time-varying and time-invarient 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) (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

Instruction Type(s): Lecture

Prerequisite(s): (ECE 5774, ECE 5744) OR (ME 5544, ME 5574) OR (AOE 5774, AOE 5744)

Corequisite(s):

AOE 6974:

Independent Study

NONE

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

NONE

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

NONE

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

Vance Pittman, Head

Professors: Kathryn Albright; Salahuddin Choudhury; James Jones; Susan Piedmont-Palladino; Humberto Rodriguez-Camilloni; Hans Rott; Robert Schubert; Mehdi Setareh; Frank Weiner; Joseph Wheeler;

Associate Professors: James Bassett; Mario Cortes; David Dugas; Kay Edge; Marcia Feuerstein; William Galloway; Howard Gartner; William Green; Shelley Martin; Margarita McGrath; Vance Pittman; Helene Renard; Heinrich Schnoedt; Gregory Tew; Steven Thompson; Lisa Tucker;

Assistant Professors: Matthew Wagner;

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. 1 option results in a post-professional degree, while 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 Environmental Systems Lab. 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.

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.

Environmental Systems Lab

Located on Price's Fork Road approx. 3 miles west of the Virginia Tech main campus in Blacksburg, the Environmental Systems Laboratory provides approximately 12,000 square feet of space, including a high-bay area with overhead crane, a wood workshop, a metal workshop with welding capability, project work areas, and a low-speed wind tunnel. Along with the Research and Demonstration Facility, this laboratory is 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.

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 will be housed in the facilities of the Washington-Alexandria Architecture Center (WAAC) in Alexandria, VA. 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)Post-Professional Degree ProgramM.Arch.1, Advanced Research and Design:The M.Arch.1, Advanced Research and Design Program is a graduate degree program intended for students who have previously obtained a five-year, professional degree in architecture (B.Arch.). Students in this program may receive advanced standing, as determined by the graduate program faculty, for up to 24 credit hours toward the completion of the 54 semester credit hours required for graduation, resulting in a typical program of study of 30 semester credit hours (minimum), generally requiring approx. one calendar year of study. Students are provided the opportunity and academic resources necessary to pursue a definitive, experimental, design investigation or research in a design-related subject area, according to their special interests. Students in the M.Arch.1 program may elect to enroll at the Washington-Alexandria Center for all or a portion of their required studies.The one-year Master of Architecture from Virginia Tech is a post-professional degree and does not constitute an accredited first professional degree in architecture. International applicants who hold architecture degrees from schools outside the U.S. and who aspire to professional licensure in the U.S. are advised to apply to the M.Arch.2 program.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 5035:

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

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

Corequisite(s):

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): 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. Bachelor's 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

Instruction Type(s): 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

Instruction Type(s): 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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): ARCH 4705 (UG)

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): 0 OR 6

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 6

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 enevelop 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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): Lecture

Prerequisite(s): ARCH 4705 (UG)

Corequisite(s):

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. I,II.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

Instruction Type(s): 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 comtemporary and historic readings, maps and drawings to illumnate differential technological, environmental, economic, social and cutural forces shaping subject cities. Research methods applicable to urban design will be dicussed. Choice of cities and areas of focus will be detemined by students based on their thesis research propsals. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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): 0 OR 6

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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): 0 OR 6
Lecture Hour(s): 0 OR 1
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, 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
Instruction Type(s): Lab
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 envionmental control, life safety and service systems, with concern for the human psycho-physical impacts of building form and system performance. Pre-requisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): Lab
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
Instruction Type(s): 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

NONE
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):

Corequisite(s):

ARCH 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ARCH 5974:

Independent Study

NONE

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):

ARCH 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ARCH 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ARCH 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ARCHITECTURE AND DESIGN RESEARCH

Vance Pittman, Head

Professors: James Jones; Patrick Miller; Humberto Rodriguez-Camilloni; Mehdi Setareh;

Associate Professors: Dean Bork; Terry Clements; Marcia Feuerstein; Brian Katen; Paul Kelsch; Mintai Kim; Lisa Tucker;

Assistant Professors: Elizabeth Grant;

Affiliated Faculty: David Lever;

Graduate Coordinator: vaughnw@vt.edu

Graduate Chair: ddugas@vt.edu

Blacksburg Program: wolverine@vt.edu

Alexandria Program: pemmons@vt.edu

Landscape Architecture Track: mintkim@vt.edu

Interior Design: ltucker@vt.edu

School of Architecture + Design: 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) Buruss 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

Environmental Systems Laboratory Washington-Alexandria Center

Center for European Studies and Architecture

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg, National Capital Region)

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.

BUILDING/CONSTRUCTION SCIENCE AND MANAGEMENT

Andrew McCoy, Head

Professors: Yvan Beliveau; Andrew McCoy; Walid Thabet;

Associate Professors: Thomas Mills; Annie Pearce; Georg Reichard; Muhsine

Turkaslan Bulbul;

Preston and Catharine White Fellow: Andrew McCoy; Georg Reichard;

Professor of Practice: Jim Yauger;

Graduate Contact: apearce@vt.edu

Building Construction: http://www.bc.vt.edu/graduate-programs

At the Master's level, the 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 entry into a Ph.D. level 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

Housing the Myers-Lawson School of Construction, the Department of Building Construction, and the Real Estate Program, Bishop-Favrao Hall is a 31,600 square foot laboratory facility opened in 2008. In addition to state-of-the-art research facilities, the building contains administrative, faculty, and graduate student offices and provides classroom space, seminar rooms, and studios for innovative learning experiences. The building is also home to multiple research labs and centers dedicated to inventing the future of the human-centered built environment. 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

Inventing the Future of the Human-Centered Built Environment

Bishop-Favrao Hall 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 200-person multimedia classrooms to 10-person conference rooms and reconfigurable studio spaces, all with full Internet and videoconferencing capabilities. Laboratories in Bishop-Favrao Hall include: Building Enclosure and Systems Technologies (BEST) Lab - for the study of building enclosure systems and their interrelated thermal, hygrothermal, and acoustic performance, as well as 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, thermal conditions, and external environmental conditions. BuildLAB - 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, a controlled ventilated welding lab space, 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. A sawmill and other equipment are located off-site, and an additional 5,000 square foot external facility and yard are also available in the CAUS Research & Demonstration Facility. Center for Innovation in Construction Safety, Health, and Well-being (IC-SAFE) - this university center provides national leadership for construction safety, health, and well-being through research, teaching, and engagement. The Center works with laboratories throughout campus to facilitate research to promote the health, safety, and well-being of construction workers and others involved in the building life cycle. Occupational & Construction Hazard Reduction Engineering (OCHRE) Lab - this lab focuses on reducing exposure to health hazards in the occupational environment. The lab's equipment includes the latest gear to identify and solve problems with indoor environmental quality, industrial hygiene, occupational health, and confined spaces, including testing equipment for work environments and sensors and monitoring equipment for workers. Sustainable Facilities & Infrastructure (SFI) Lab - this distributed lab 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. 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. Virtual Facilities Research Lab - this 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)

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GRE

General: Verbal, Quantitative, Analytical

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 Requirements: GRE scores are required from all international applicants and may be required for domestic applicants based on background and education. Domestic students who would like to be considered for fellowships and other financial assistance should take the Graduate Record Exam and submit scores as part of the application. TOEFL Requirements: 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. A minimum score of 105 on the iBT or equivalent is required. Application Deadlines: All required documents must be received in the Graduate School by the BC 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 term only. (Military can request a spring start.) The Department conducts a rolling admission review, with admissions decisions made within one month after application. The deadlines below are the latest possible dates that an application will be considered. Students applying after these deadlines will be considered for admission in the subsequent year. Please apply as early as possible. Students wishing to be considered for assistantship funding should apply no later than March 1 for fall admission. International Students : Application Deadline for M.S. applicants is March 1st. The decision deadline is on or about April 1st. Domestic Students : Application Deadline for M.S. applicants is July 1st. The decision deadline is on or about August 1st.

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 are well-prepared to develop cutting edge 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 the construction faculty.

Research Track

The Research Track offers a chance for students who wish to explore an industry problem at a more detailed 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 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

BC 5064:

Innovation in Construction

An introduction to the role of innovation in the construction industry, including the explanation of theories within the realm of innovation, diffusion, adoption, new product development, supply chain management, sustainability, information technology and commercialization. The course emphasizes application of these theories to construction industry innovation through the development and administration of a survey instrument and interviews that culminating in a case study of best practice for innovation development. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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
Instruction Type(s): 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): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, 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 (CNST 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
Instruction Type(s): 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 builids 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
Instruction Type(s): Lecture
Prerequisite(s): BC 5514 OR BC 55514 (UG)
Corequisite(s):

BC 5904:
Project and Report
NONE
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
NONE
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
NONE
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
NONE
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ENVIRONMENTAL DESIGN AND PLANNING

Andrew McCoy, Head

Professors: Yvan Beliveau; Andrew McCoy; Walid Thabet;
Associate Professors: Thomas Mills; Annie Pearce; Georg Reichard; Muhsine Turkaslan Bulbul;
William Jamerson Professor: Walid Thabet;
Preston and Catharine White Fellow: Andrew McCoy; Georg Reichard;
Professor of Practice: Jim Yauger;

Graduate Contact: apearce@vt.edu
Graduate Site: http://www.bc.vt.edu/graduate-programs

The Environmental Design and Planning (EDP) program in the Myers-Lawson School of Construction 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, operations, and end-of-life-cycle, providing the basis to contribute to the construction field from positions in either industry or academia. Applicants must demonstrate the capability to undertake advanced academic study including independent research. While a prior degree in construction 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 30 hours of core coursework.

SPECIAL FACILITIES
Housing the Myers-Lawson School of Construction, the Department of Building Construction, and the Real Estate Program, Bishop-Favrao Hall is a 31,600 square foot laboratory facility opened in 2008. In addition to state-of-the-art laboratory spaces, the building contains administrative, faculty, and graduate student offices and provides classroom space, seminar rooms, and studios for innovative learning experiences. 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

Inventing the Future of the Human-Centered Built Environment

Bishop-Favrao Hall 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 200-person multimedia classrooms to 10-person conference rooms and reconfigurable studio spaces, all with full Internet and videoconferencing capabilities. Laboratories in Bishop-Favrao Hall include: Building Enclosure and Systems Technologies (BEST) Lab - for the study of building enclosure systems and their interrelated thermal, hygrothermal, and acoustic performance, as well as 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, thermal conditions, and external environmental conditions. BuildLAB - 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, a controlled ventilated welding lab space, 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. A sawmill and other equipment are located off-site, and an additional 5,000 square foot external facility and yard are also available in the CAUS Research & Demonstration Facility. Center for Innovation in Construction Safety, Health, and Well-being (IC-SAFE) - this university center provides national leadership for construction safety, health, and well-being through research, teaching, and engagement. The Center works with laboratories throughout campus to facilitate research to promote the health, safety, and well-being of construction workers and others involved in the building life cycle. Occupational & Construction Hazard Reduction Engineering (OCHRE) Lab - this lab focuses on reducing exposure to health hazards in the occupational environment. The lab's equipment includes the latest gear to identify and solve problems with indoor environmental quality, industrial hygiene, occupational health, and confined spaces, including testing equipment for work environments and sensors and monitoring equipment for workers. Sustainable Facilities & Infrastructure (SFI) Lab - this distributed lab 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. 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. Virtual Facilities Research Lab - this 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)

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GRE

General Test: Verbal (400.0), Quantitative (600.0), Analytical (4.0)

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, operations, and end-of-life-cycle, providing the basis to contribute to the construction field from positions in either industry or academia. The Ph.D. in Environmental Design and Planning is a STEM-designated degree. All applicants to the EDP Program must demonstrate the capability to undertake advanced academic study 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 30 hours of core 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 from all international applicants and may be required for domestic applicants based on background and education. Domestic students who would like to be considered for fellowships and other financial assistance should take the Graduate Record Exam and submit scores as part of the application. 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 or equivalent 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 accepts applications for 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 conducts a rolling admission review, with admissions decisions made within one month after application. The deadlines below are the latest possible dates that an application will be considered for fall admission. Students applying after these deadlines will be considered for admission in the subsequent year. Please apply as early as possible. Students wishing to be considered for assistantship funding should apply no later than March 1 for fall admission, and should directly contact faculty as soon as possible with whom they are interested to work to discuss their interests and funding needs. International Students : Application Deadline for Ph.D. applicants is March 1st for fall admission. The decision deadline is on or about April 1st. Domestic Students : Application Deadline for Ph.D. applicants is July 1st for fall admission. The decision deadline is on or about August 1st.

GRADUATE COURSES (EDP)

EDP 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDP 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDP 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

LANDSCAPE ARCHITECTURE

Terry Clements, Chair

Emeriti Faculty: Benjamin Johnson;

Professors: Terry Clements; Patrick Miller;

Associate Professors: Dean Bork; Wendy Jacobson; Brian Katen; Paul Kelsch; Mintai Kim; Laurel McSherry;

Assistant Professors: Cermetrius Bohannon;

Adjunct Professors: Sarah Couchman; Michael Ezban; Douglas Hays; David Hill;

Director of NCR MLA Program: Laurel McSherry;

Graduate Program Director: mintkim@vt.edu

Grad. Director Northern VA: lm@vt.edu

Program Administrator: tphipps@vt.edu

Master's in Landscape Architecture: http://lar.vt.edu/academics/about-mla/

First Professor Masters in Landscape Architecture:

http://lar.vt.edu/academics/about-mla/3-year-first-professional-mla-program/

Landscape Architecture Program: http://lar.vt.edu

Ph.D. in Architecture and Design Research - Landscape Architecture track:

http://lar.vt.edu/academics/phd/

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 MLA, a 2-year advanced MLA, 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 program. The first-professional degree program's studio-based curriculum integrates design, ecology, fabrication, and representation. Applicants with a previous degree in landscape architecture, architecture or an allied area may be admitted to the two-year MLA program, 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 graduates routinely find work in design and planning firms, governmental 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. 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; re-imagining water, food, energy and transportation; green infrastructure; remediation of spoiled and disturbed sites; and preserving critical natural resources.

SPECIAL FACILITIES

FacilitiesThe Land Design & Simulation Lab 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. 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. See: http://cdac.arch.vt.edu/ The Washington-Alexandria Architecture Center The Washington-Alexandria Architecture Center (see www.waac.vt.edu for more information) allows students to address the complexities of urban areas, using the National Capital Region (NCR) as a resource laboratory for design and research. The Washington, DC metropolitan area possesses many cultural and educational resources, including the various facilities of the Smithsonian Institution, the American Institute of Architects, the Library of Congress, and the National Building Museum. The Center, established in 1980 as an urban extension of the College, provides numerous opportunities in which students can pursue their selected programs of study. The Washington-Alexandria Architecture Center's academic buildings are located within the historic district of Old Town, Alexandria, Virginia, providing studios, a library, shops, darkrooms, computer labs, and classrooms. The Center also maintains a 23 unit apartment building. All facilities are located within a four block radius and form an urban campus of historic structures.

DEGREES OFFERED

MLA Degree

Offered In (Blacksburg, National Capital Region)

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 offered at the National Capital Region Campus, the two-year post-professional MLA, offered on the Blacksburg Campus, and the one-year plus thesis MLA for those with significant professional experience, offered at Blacksburg Campus. A PhD focussed on landscape architecture is offered through the School of Architecture + Design's PhD in Architecture and Design Research. The three-year first-professional Master of Landscape Architecture is an accredited three-year professional degree designed for individuals who have completed a bachelor's degree in a field other than landscape architecture. The program offers a studio-based curriculum integrating design, ecology, fabrication, and representation. Emphasis is given to developing mastery of design through a series of design studios that investigate a range of landscape scales from sites to regions. The program seeks applicants whose academic and professional interests focus on the civic landscape. The first professional MLA program is offered through the Washington -Alexandria Architecture Center (WAAC) in Old Town Alexandria, which operates as the metropolitan extension of the College of Architecture and Urban Studies' School of Architecture + Design in Blacksburg. Established in 1998, the program's location within the National Capital Region enables interdisciplinary collaboration with architecture, natural resources, and planning programs and contact with myriad public and private cultural and artistic institutions (e.g. American Society of Landscape Architects, National Building Museum, American Institute of Architects, Library of Congress, and museums of the Smithsonian Institution). 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, and evidence of potential to successfully pursue graduate-level work in landscape architecture. Preference is given to candidates with high academic standing and whose record reflects a balanced undergraduate education in the arts, sciences, and humanities. Although our students have varied educational backgrounds and experience, college-level courses in the natural sciences, ecology, and the visual arts (e.g., drawing, sculpture, printmaking, and/or basic design) are strongly recommended. 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. Admitted candidates will be recommended for the Master of Landscape Architecture professional degree upon satisfactory completion of a minimum of 75 credit hours (25 credits hours of Foundation Studies plus a minimum of 50 credit hours of MLA Studies) including a thesis. Foundation Studies prepare students to perform at the graduate level and include introductory course work in history, theory, design, technique, and natural systems. MLA studies include a sequence of required studios, core coursework, and directed electives. Studios introduce the thematic interests of the faculty and highlight different approaches to design with respect to inquiry and process. Directed electives, which support the development of a particular area of mastery, may be taken from various areas of study including but not limited to landscape architecture, architecture, visual arts, natural resources, and urban affairs and planning. Graduate Studies culminate with a design thesis directed by a major professor. See: 3-year First-professional MLA Program. The 2-Year post-professional MLA is an advanced program tailored for students who already hold a first professional-degree in landscape architecture, architecture or another closely related field. Offered primarily on the Blacksburg campus, the 2-year MLA program is dedicated to the advancement of knowledge and to our understanding of landscape architecture within three areas of faculty expertise: Community and Place, Ecological Design, and Design Learning. Applicants are asked to identify their specific area of research interest upon application. Each student in the two-year, 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. Ten 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 Masters of Landscape Architecture A studio-based two-year post-professional degree is available at the National Capital Region (NCR) campus for students who already hold a first-professional degree in landscape architecture or architecture. The 1 Year Plus Thesis MLA, offered at Blacksburg Campus, is an accelerated scholastic 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 in an individually tailored program. See: Advanced Masters of Landscape Architecture Dual Degree Programs: MLA students may pursue a simultaneous master degree in either Urban and Regional Planning (MLA/MURP) or Natural Resources (MLA/MNR). 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. MLA/MNR Dual Degree Program coordinates course requirements in both fields, taking full advantage of the on-line MNR offerings to students located in the NCR. The MNR prepares students for careers in environmental sustainability as natural resource, environmental, and sustainability professionals. Off Campus Studies: MLA students may take elect to participate in the Virginia Tech 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, National Capital Region)

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. Typically, students entering the Ph.D. program wish to pursue an academic career.

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: undegraduate 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

Instruction Type(s): Lab, 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: undegraduate 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

Instruction Type(s): Lab, Lecture

Prerequisite(s): LAR 4705, LAR 4706

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 country's 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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): LAR 3004

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

Instruction Type(s): 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

Instruction Type(s): 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

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

LAR 5334:
Landscape Architecture History
Historical development of landscape architecture with emphasis on western culture from Acient Greece through the 20th Century. Enphasis 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

LAR 5344:
Scholarship of Place
Theory and scholarly methods related to snese 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 characterists 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. Pre-requisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): LAR 5264
Corequisite(s):

LAR 5704:
Advanced Landscape Design and Planning Lab
Studio addressing advanced problems in landscape design and planning. I
Credit Hour(s): 0 OR 5
Lecture Hour(s): 0 OR 1
Instruction Type(s): Lab, Lecture
Instruction Type(s): Lab, 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. 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):

LAR 5754:
Thesis Studio
Thesis studio is an alternative to the conventional academic thesis for students pursuing a master's 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. I, II

Credit Hour(s): 1 TO 19

Lecture Hour(s): 0 TO 19

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 tes or demostrate the design resolution of problems in the student's research area.

Credit Hour(s): 6

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):   LAR 5314

Corequisite(s):

LAR 5964:

Landscape Architecture Field Studies

NONE

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

LAR 5974:

Independent Study

NONE

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):

LAR 5984:

Special Study

NONE

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):

LAR 5994:

Research and Thesis

NONE

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

Joel Peters, Head

Emeriti Faculty: James Bohland;

Professors: Terry Clements; Anne Khademian; Paul Knox; Ilja Luciak; Timothy Luke; Patrick Miller; Joel Peters; Thomas Sanchez; Max Stephenson; Gerard Toal; Edward Weisband;

Associate Professors: Ariel Ahram; David Bieri; Dean Bork; Ralph Buehler; Giselle Datz; Matthew Dull; Ralph Hall; Wendy Jacobson; Laura Jensen; Paul Kelsch; Mintai Kim; Laurel McSherry; Patricia Nickel; Joseph Rees; Patrick Roberts; Ioannis Stivachtis; Diane Zahm; Yang Zhang;

Assistant Professors: Cermetrius Bohannon; Steven Hankey; Nathan Heavers; Shalini Misra; Todd Schenk; Thomas Skuzinski; Wenwen Zhang; Raymond Zuniga;

University Distinguished Professor: Paul Knox; Timothy Luke;

Edward S. Diggs Professor in the Social Studies: Edward Weisband;

Associate Professor of Practice: Elizabeth Morton;

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 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 Landscape/Environmental Planning & Landscape Analysis Transportation Planning Physical

Planning & Urban Design Governance & Globalization TrackThematic Areas: Governance, Institutions, & Civil Society Globalization, Identities, Security, & Economies

SPECIAL FACILITIES

PGG Studio The PGG studio is an open office space exclusive to the PGG students. Located in the Media Annex, next door to the Architecture Annex, this space has individual desks, lounge area, kitchen area, and computer space for student access. So far, students use the studio area in different ways: some spend most of their working time at their desks in the studio; some stop by a few hours every day to check their emails and to work between classes; and others never use the studio choosing to work at their homes or in their departments.SPIA is associated with one university-wide center (VCHR), one college institute (MI), 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 Metropolitan Institute (MI) conducts basic and applied research on national and international development patterns, focusing on key forces shaping metropolitan growth such as demographics, environment, technology, design, transportation, and governance. It seeks to expand knowledge in urban and metropolitan affairs in order to improve policy and practice, and educate the general public on important issues facing communities.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.

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 6006 (Pedagogy) or in extraordinary circumstances, when 6006 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 9-hour, 3 course core requirements:Accordingly, all students would take 12 credit hours of common core courses (all existing): Pedagogy: SPIA 6006 Theory: 1 course, 3 credits. Satisfied by completion of SPIA 6104 Planning Theory Seminar, GIA/UAP 5524 (Critical Perspectives on Development & Globalization), GIA/UAP 5004 (Power and Policy in the U.S.), EDP 6005 (Seminar in Epistemology), GIA/PSCI 5214/5224 (Contemporary/Alternative Political Theory), or equivalents. Methods: Research design and quantitative and/or qualitative methods, 2 courses, 6 credits. Satisfied by successful completion of UAP 5484/GIA 5464 (Advanced Research Methodology), UAP 5494 (Advanced Quantitative Techniques), GIA 5504 Discourse Analysis, GIA/PSCI 5115/5116, or equivalents. Research (30 credits): GIA/UAP 7994 Research and Dissertation. In addition, the Governance & Globalization track requires proficiency in a foreign language for scholarly purposes as a research tool. Each student will work with her or his doctoral coordinating committee to develop a strategy for fulfilling this requirement.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 (all existing): Pedagogy: SPIA 6006 SPIA 6104 Planning Theory Seminar - 3 credits. Planning epistemology and theory. 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. Research design and quantitative and/or qualitative methods, 6 credits. Satisfied by successful completion of UAP 5484 (Research Methodology - 3 credits) and UAP 5494 (Advanced Quantitative Techniques - 3 credits), or equivalents. Research (30 credits): GIA/UAP 7994 Research and Dissertation. In addition, proficiency in a foreign language is required if appropriate to student's dissertation in the UEDP track.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" the student continues to take coursework as outlined in the plan of study. At the completion of coursework, the student will undertake the "preliminary examination", a formal assessment of the 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.

PUBLIC ADMINISTRATION AND PUBLIC AFFAIRS

Brian Cook, Chair

Emeriti Faculty: Larkin Dudley; Charles Goodsell; Philip Kronenberg; Gary Wamsley;

Professors: Brian Cook; Karen Hult; Anne Khademian;

Associate Professors: Matthew Dull; Laura Jensen; Joseph Rees; Patrick Roberts;

Assistant Professors: Adrienne Edisis; Sara Jordan;

Assistant Professor of Practice: Stephanie Davis;

General Contact: cpap.vt@gmail.com

Graduate Contact: mlechuga@vt.edu

General Contact: sddavis@vt.edu

General Contact: aedisis@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, the National Capital Region (NCR), and Richmond. The Ph.D. is offered in Blacksburg and NCR. CPAP also is the home for two graduate certificates, in Homeland Security Policy and in Local Government Management.

SPECIAL FACILITIES

Beyond the main campus, CPAP offers students opportunities to earn the M.P.A. and the Ph.D. in the rich learning environments of Old Town Alexandria, VA (adjacent to Washington, DC) and Richmond, VA, the state capital (M.P.A. only).

Beyond the Blacksburg campus

In addition to Blacksburg, CPAP offers students opportunities to earn graduate degrees in the rich learning environments of the National Capital Region (M.P.A. and Ph.D.) and Richmond, VA (M.P.A.)

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 PhD students.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

GMAT

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. We require all PhD applicants to submit scores from one of the following graduate admissions tests: GRE or GMAT.

MPA Degree

Offered In (Blacksburg, Richmond, 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. Entering MPA students must have taken at least one undergraduate course on the institutions of U.S. government or have equivalent work experience or training. All students must also have taken an introductory statistics course or be taking one concurrently in order to enroll in PAPA 6514. To enroll in PAPA 6224, students must have completed statistics and PAPA 6514 or the equivalent.Test scores (GRE or GMAT) for MPA applicants are optional.

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
Instruction Type(s): 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:

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 manager's 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:

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

PAPA 5254:

Hmlnd Sec & 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, America's foreign and domestic policy responses to 9/11, and straregic and operational homeland security functions. Pre-requisite: Graduate standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5354:

HmInd Sec & 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 resourse challenges of multi-jurisdictional response planning and operation execution. Pre-requisite: Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5674 (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):

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

Instruction Type(s): 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

NONE

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5974:

Independent Study

NONE

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):

PAPA 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PAPA 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PAPA 6454:

Advanced Topics in Ethics and the Public Sector

This is an advanced course in the Center's 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

Instruction Type(s): 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

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

PAPA 6984:

Special Study

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

PAPA 7994:

Research and Dissertation

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

URBAN AND REGIONAL PLANNING

Thomas Sanchez, Chair

Emeriti Faculty: James Bohland; John Randolph;
Professors: Paul Knox; Thomas Sanchez; Max Stephenson;
Associate Professors: David Bieri; Ralph Buehler; Ralph Hall; Diane Zahm; Yang Zhang;
Assistant Professors: Steven Hankey; Shalini Misra; Todd Schenk; Thomas Skuzinski; Wenwen Zhang;
Adjunct Professors: Shelley Mastran;
Professor of Practice: Elizabeth Morton;

UAP Home: http://www.uap.vt.edu
Graduate Site: http://www.uap.vt.edu/degrees/masters

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 "generalist" planning theories and skills, and constitute approximately one-half of the MURP curriculum. The remaining credit hours allow each student to develop an individualized area 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 American Planning Association Planning Accreditation Board.The UAP graduate program is offered in two locations: the main campus in Blacksburg and in Old Town Alexandria (National Capital Region).

SPECIAL FACILITIES

Architecture Annex in Blacksburg and 1021 Prince Street, Alexandria VA, Northern Capitol Region

DEGREES OFFERED

MURPL Degree

Offered In (Virtual, Blacksburg, National Capital Region)

TOEFL

Original Test: (550.0)

IELTS: (6.5)

IBT Test: (80.0)

GRE

Old Exam: Verbal (530.0), Quantitative (630.0)

Current Exam: Verbal (155.0), Quantitative (150.0)

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 5174 Theory and Practice of Urban and Regional PlanningUAP 5224 Quantitative Techniques in Planning, plus a second methods offeringUAP 5554 Land Use LawUAP 5124 Urban and Regional Planning Studio, plus a second “specialty” studioUAP 5234 Urban Economy and Public Policy Applying for Admission : Interested students should use Graduate School's online system to apply. The MURP program requires applicants to submit an online application form, application fee, official transcripts of previous academic work, personal statement, three letters of recommendation, and resume. In addition, all applicants who did not earn an undergraduate degree from a university in the US must submit GRE scores, and 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, for example, Natural Resources, Public Administration, or Landscape Architecture. 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, and Metropolitan Studies, 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:

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

Instruction Type(s): 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:

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5074G:

Adv Comm Renewable Energy Sys

Critical review of energy issues from local to international including economic, envrionemtnal, and soical 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. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): UAP 5224

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

Instruction Type(s): 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

NONE

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:

Adv Land Use & Env: Plan & Pol

Environmental factors involved in land use planning and development, including topography, soils, geologic hazards, flooding, and sotrm water management, ecological features and visual quality. Techniques for conducting envronmental land inventories and land use suitability analyses. Policies and programs to protect environmental quality in land use 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):

UAP 5164:

Collaborative Governance and Civil Society

Theoretical foundations of collaborative policy and governance approaches are examined. Strategies and methods for forming and sustaining collaborative coalitions are discussed. Case studies are used to illustrate the effectiveness of collaborative approaches in different policy domains. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 5194:

Urban Growth Mgmt

Examines regulatory and financial techniques for controlling and guiding urban development. Evaluates their advantages and disadvantages with respect to development circumstances. Focus is primarily on the practice of local and state governments in the U.S. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): UAP 4754

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 maxiumum of 9 credit hours. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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 institutiuons 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. 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):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5454:

Nonprofit Organization & Management

Examines the nonprofit sector in American society and compares those roles with the roles the sector plays in other advanced democracies as well as in developing countries. Also analyzes the role of important sub sectors within the nation's third sector and explores key management challenges confronting non-profit organization leaders with them. Compares those challenges to those found in nongovernmental

organizations in developing nations. 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 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): UAP 5484
Corequisite(s):

UAP 5504 (GIA 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):

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
Instruction Type(s): 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): null null
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:

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:

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5594:

Nonprofit 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 nongovernamental organizations. Also surveys current theories of nonprofit/nongovernmental organization regulation as well as major legal and ethical issues confronting the sector. 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 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

Instruction Type(s): Lecture

Prerequisite(s): UAP 5234

Corequisite(s):

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. I,II.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

Instruction Type(s): 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
Instruction Type(s): 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): CEE 3604
Corequisite(s):

UAP 5674 (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 determie 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 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
Instruction Type(s): 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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 oontexts 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
Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5794:

Environ Plan Studio

Application of environmental planning techniques involving either land use or residuals mangement in a specific project.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): UAP 5124 OR UAP 5144

Corequisite(s):

UAP 5854G:

Adv Plan Urban Infrastructure

Elements of the built environment and the policy/planning structure of the city. Elements associated with the primary urban activited (residential, commercial, industrial), as well as the urban form-giving infrastructure facilities that support those land uses (water supply, sewerage, solid waste disposal, transportation, education, recreation, health, and safety). Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5904:

Project and Report

I

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. Pre-requisite: Garduate Standing and enrollment in the Masters International Program and Peace Corps.

Credit Hour(s): 6

Lecture Hour(s): 6

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5924:

Peace Corp Enrollment

NONE

Credit Hour(s): 0

Lecture Hour(s): 0

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5964:

Field Study

I

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

UAP 5974:

Independent Study

I

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

UAP 5994:

Research and Thesis

I

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

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

AGRICULTURAL AND APPLIED ECONOMICS

Darrell Bosch, Head

Professors: Jeffrey Alwang; Darrell Bosch; Kevin Boyle; Richard Crowder; George Davis; Michael Ellerbrock; Leighton Geyer; Achla Marathe; Mary Marchant; Bradford Mills; Klaus Moeltner; George Norton; James Pease; Everett Peterson; Stephen Stephenson;

Associate Professors: Jason Grant; Gordon Groover; Olga Isengildina Massa; Wen You;

Assistant Professors: Catherine Larochelle; Kimberly Morgan; Travis Mountain; Clinton Neill; Ford Ramsey;

Professor and Thornhill Endowed Chair in Agricultural Trade: Richard Crowder;

General Contact: nadams10@vt.edu

Student Handbook:

http://aaec.vt.edu/content/dam/aaec_vt_edu/graduate/academic-information/StudentPLanningGuide2016-v3.pdf

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

Offered In (Blacksburg)

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 32 semester hours, including 26 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

Offered In (Blacksburg)

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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

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

Corequisite(s):

AAEC 5025:

Applied Microeconomic

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

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 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. II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): AAEC 5125 (UG) OR AAEC 5125

Corequisite(s):

AAEC 5134:

Agricultural Marketing

Concepts of technical and economic efficiency as they are related to the flow of agricultural products from farm to consumer. Major topics include: market equilibrium over time, space and form; price discovery under different market structures, and price risk management with futures and options. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

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

Corequisite(s):

AAEC 5144:

Resource and Environmental Economics

Economic theory and methods are applied to analysis of the uses of natural resources, environmental problems and public investment planning. The contribution of economic analysis to public policy formulation is stressed. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

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

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. II

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

AAEC 5904:

Project and Report

NONE

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

Instruction Type(s): Lecture

Prerequisite(s): ECON 2115 (UG) OR ECON 2115 OR ECON 2116 (UG) OR ECON 2116 OR ECON 2005 (UG) OR ECON 2005 OR ECON 2006 (UG) OR ECON 2006 OR ECON 2125 (UG) OR ECON 2125 OR

ECON 2126 (UG) OR ECON 2126 OR ECON 2025H (UG) OR ECON 2025H OR ECON 2026H (UG) OR ECON 2026H
Corequisite(s):

AAEC 5954:
Study Abroad
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

AAEC 5974:
Independent Study
NONE
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):

AAEC 5984:
Special Study
NONE
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
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

AAEC 6004:
Seminar
Formal presentation and discussion of current problems, programs, and research studies in agricultural economics including projects employing advanced theoretical and quantitative techniques. Presentations and discussions. Repeatable for credit, up to 3 (M.S.) or 4 (Ph.D.) times.
I,II,III,IV
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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
Instruction Type(s): 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): ECON 5006
Corequisite(s):

AAEC 6554 (ECON 6554):

Panel Data Econometerics

Introduction to major panel data techniques and modeling ideas currently employed (e.g., dynamic panel, panel for descrete 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
Instruction Type(s): Lecture
Prerequisite(s): (AAEC 5124 OR ECON 5124), AAEC 5126
Corequisite(s):

AAEC 6564 (STAT 6564) (ECON 6564):

Bayesian Economics 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

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

AAEC 7994:

Research and Dissertation

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

AGRICULTURE, LEADERSHIP, AND COMMUNITY EDUCATION

Rickie Rudd, Head

Professors: Rickie Rudd;

Associate Professors: Curtis Friedel; Eric Kaufman; Kimberly Niewolny; Donna Westfall-Rudd;

Assistant Professors: Thomas Archibald; Jennifer Culhane; Tiffany Drape; Richard Rateau; Hannah Scherer; Megan Seibel;

Community Viability Chair of Excellence: Rickie Rudd;

Graduate Contact: shwilli4@vt.edu

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

The Department of Agricultural, Leadership, and Community Education (ALCE) is nationally recognized as a comprehensive program encompassing teaching and learning, extension, 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, community viability, and leadership & social change.

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 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. Our Teaching and Learning Laboratory is located in room 244. This state of the art laboratory is utilized in conducting research in a classroom setting to test teaching and learning theory and study other phenomena where people are faced with stimuli in a social science setting.

DEGREES OFFERED

MS Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The department offers a M.S degree and partners in two other M.S. degree programs. The department offers a M.S. in Life Sciences with an emphasis in Agricultural Education (MS). We are a partner in the College of Agriculture and Life Sciences for the ALS (MS) degree. In addition, we are a partner with the Virginia Tech School of Education in offering an M.S. degree for agriculture teacher certification MSED/EDCT. MSLF/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. 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 partnership 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: (213.0)

iBT: (80.0)

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 or extension education. Our program focus allows us to deliver a customized program for students preparing for the Professoriate. Courses, experiences, and research are all focused on providing a solid foundation for future faculty who will be initially competitive and highly productive throughout their career. Our Ph.D. program provided a solid background in research and students are expected to produce unique discoveries in teaching and learning, community viability, 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 program. 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 5004:

Teaching Practice Ag Life Sci

Preparation of critically reflective and skillful college teachers in agriculture and life sciences. Theories, principles and practices associated with effective teaching in higher education. Understanding and development of skills and abilities related to teaching and learning. 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):

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 5024:

Supervised Experience Programs in Agriculture

Designed to provide information and assistance for developing and conducting a supervised occupational experience program. Includes identification of principles and trends in occupational experience programs, procedures in conducting an occupational experience program, and evaluation of experience 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):

ALCE 5034:

Teaching Agric Mechanics

The coordination of essential elements required for an effective agricultural mechanics program. Special emphasis placed upon integration agricultural mechanics instruction into a local agricultural education program, liability, curriculum content selection, special teaching methodologies and student assessment.

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 conmmunity 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, effectivness, 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 cummunity 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 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 5764:

Externship in ALCE

Students participate in a special interdisciplinary problem- solving approach for experienced agricultural education and extension professionals who are engaged in part-time graduate study while continuing in positions of leadership. Interdisciplinary teams of faculty work with small groups of experienced professionals in systematic analysis of contemporary issues. Students are judged on quality of their investigations, individual reports, and delivery of subject matter. (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):

ALCE 5904:

Project and Report

NONE

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

NONE

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

NONE

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

NONE

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

NONE

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

NONE

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:

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. Priciples 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: Preperation 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 facutly positions with teaching appointments. Preperation 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)
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 6984:
Special Study
NONE
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
NONE
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
NONE
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):

AGRICULTURAL AND LIFE SCIENCES

Professors: Renee Boyer; Carlyle Brewster; Walter Daniels; George Norton; Douglas Pfeiffer; Kerry Redican; Rickie Rudd; Elena Serrano; Susan Sumner; Gregory Welbaum; Kang Xia;
Associate Professors: Antonius Baudoin; Susan Day; Alan Ealy; Matthew Eick; Joseph Eifert; John Galbraith; William Hession; Matthew Hulver; Eric Kaufman; Kimberly Niewolny; Sally Paulson; Holly Scoggins; Donna Westfall-Rudd; James Westwood;
Assistant Professors: Thomas Archibald; Jennifer Culhane; Tiffany Drape; Curtis Friedel; Madlyn Frisard; Vitor Mercadante; Carlin Rafie; Hannah Scherer; Karen Vines; Robert Williams;
Affiliated Faculty: Michelle Rockwell; Linda Taylor;

General Contact: jejone18@vt.edu
Academic Progress: jejone18@vt.edu
Graduate Site: http://www.cals.vt.edu/online/index.html

This degree program has been designed for potential students who are place-bound, whether because of professional or family commitments. Courses and the project are arranged to meet the goals of the student. The student selects from a list of six concentration areas: (1) Applied Nutrition and Physical Activity; (2) Education; (3) Environmental Science; (4) Food Safety and Biosecurity; (5) Leadership Studies; and (6) Plant Science and Pest Management. In addition to course work in the chosen Concentration Area, courses are required from a Core Curriculum.

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

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The student designs a program of at least 30 credits. Seven of these must include courses in the core area, including one credit hour of ALS 5904. Each student selects 12 credit hours from the selected concentration area. Six credit hours are selected as electives, generally from another concentration. Five credit hours are taken in the form of research hours within the concentration area, culminating in a final scholarly report.

GRADUATE COURSES (ALS)

ALS 5004:

Animal Nutrition Seminar

Reports and discussion of current research in animal nutrition on an inter-departmental basis. May be repeated. II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ALS 5014:

Seminar in Plant Physiology

Formal presentation of principles and concepts in plant physiology. Review, discussion and critical evaluation of current primary literature and research data. May be repeated. II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ALS 5034:

Mathematical Modeling of Metabolic Systems

Techniques used to model nutrient metablolism 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ALS 5064 (BIOL 5064) (PPWS 5064) (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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

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

Corequisite(s):

ALS 5115:

Nutrition

Digestion, absorption and metabolism of nutrients in animals including humans. 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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

ALS 5116:

Nutrition

Digestion, absorption and metabolism of nutrients in animals including humans. 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

Instruction Type(s): Lecture

Prerequisite(s): ALS 5115

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): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 5234G:

Adv Concepts Comm Food Systems

Examination of the economic, political, social, and cultural issues related to community food systems and agricultural practices. Topics include 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-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):

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. I

Credit Hour(s): 0 OR 5

Lecture Hour(s): 0 OR 4

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 enchance professional preparation in agriculture and life sciences. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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 5504:

Quantitative Genetics Applications of Matrix Algebra

Tools in quantitative genetics utilized for describing and solving problems in the agriculture and life science, with particular focus on matrix algebra. Utilize matrix algebra into genetic application, conduct matrix operations, identify the determinant and inverse of a matrix, determine linear independence, dependence and rank, use linear equations, generalized inverse, and latent roots and vectors to solve complex issues in advanced quantitative genetics. 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): ALS 5304

Corequisite(s):

ALS 5904:

Project and Report

NONE

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
NONE
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
NONE
Credit Hour(s): 1 TO 12
Lecture Hour(s): 1 TO 12
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ALS 5974:
Independent Study
NONE
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):

ALS 5984:
Special Study
NONE
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, lacatation, reproduction, homeostatis, 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
Instruction Type(s): Lecture
Prerequisite(s): (ALS 5304 (UG) OR ALS 5304) OR ALS 5344
Corequisite(s):

ALS 6984:
Special Study
NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ALS 7964:
Field Studies
NONE
Credit Hour(s): 1 TO 12
Lecture Hour(s): 1 TO 12
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

ANIMAL AND POULTRY SCIENCES

David Gerrard, Head

Professors: Rami Dalloul; Donald Denbow; Mark Estienne; David Gerrard; Scott Greiner; Honglin Jiang; James Knight; Edward Smith; Eric Wong;
Associate Professors: Mark Cline; Alan Ealy; Joseph Eifert; Dan Eversole; Elizabeth Gilbert; Sally Johnson; Michael Persia; Robert Rhoads; Michelle Rhoads; Cynthia Wood;
Assistant Professors: Susan Campbell; Samer El-Kadi; Erica Feuerbacher; Leonie Jacobs; Timothy Jarome; Kiho Lee; Caroline Leeth; Bridgett McIntosh; Vitor Mercadante; Robin White; Thomas Wilson;
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 34 faculty members who serve the needs of about 500 undergraduate and about 50 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: (80.0)

GRE

General Test: Verbal (150.0), Quantitative (150.0), Analytical (3.0)

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: (80.0)

GRE

General Test: Verbal (150.0), Quantitative (150.0), Analytical (3.0)

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. I,II,III,IV

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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, reserach 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 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): ALS 5304
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. I,II,III
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): 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. I,II,III
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
NONE
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):

APSC 5984:
Special Study
NONE
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
NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

APSC 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

APSC 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BIOCHEMISTRY

Glenda Gillaspy, Head

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

Associate Professors: Richard Helm; Michael Klemba; Robert White;

Assistant Professors: Anne Brown; Brandon Jutras; Justin Lemkul; Zachary Mackey; Daniel Slade; Clement Vinauger Tella;

Affiliated Faculty: Carla Finkielstein; James Mahaney; Florian Schubot;

Director, Fralin Life Sciences Institute: Dennis Dean;

Research Assistant Professors: Chloe Lahondere;

General Contact: smearly@vt.edu

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

Student Handbook: https://www.biochem.vt.edu/Graduate.html

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 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 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, and proteomics and metabolomics facility.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

GRE

General Test: Verbal, Quantitative

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.

MSLFS Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

GRE

General Test: Verbal, Quantitative

The Graduate Program in Biochemistry is a doctoral degree program. In rare instances, students may earn Masters degrees. M.S. (thesis based) students must take a minimum of 20 hours of coursework (12 credits of 5000-level or higher). Specific course requirements* include Principles of Biochemistry (BCHM 5115-5116, 8 hours), Seminar in Biochemistry (3 hours), Biometry (STAT 5605**) or Statistics in Research (STAT 5615; 3 hours), Information Systems in the Life Sciences (ALS 5984, 3 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. **Recommended

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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BCHM 5064 (BIOL 5064) (ALS 5064) (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. Graduate status in participating MCBB departments required. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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 metabloism. Not available to Biochemistry majors. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 agrocultural problems. Genre characterization and manipulation, protein-based drugs, diagnostics, vaccines, transgenic plants/animals. Advanced analysis, critique, application of research in molecular life science. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BCHM 5974:

Independent Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

BCHM 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BCHM 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

DAIRY SCIENCE

Benjamin Corl, Interim Head

Professors: Robert Akers; Mark Hanigan; Katharine Knowlton;

Associate Professors: Benjamin Corl; Christina Petersson-Wolfe;

Assistant Professors: Rebecca Cockrum; Kristy Daniels; Gonzalo Ferreira;

Horace E. and Elizabeth F. Alphin Professor: Robert Akers;

David R. and Margaret Lincicome Professor of Agriculture: Mark Hanigan;

Colonel Horace E. Alphin Professor: Katharine Knowlton;

Robert Akers: rma@vt.edu

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

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. A minimum TOEFL score of 550 (paper based test) , 213 (computer based test), or 80 for Internet. Three letters of recommendation are required. We strongly encourage applicants to have online recommendations completed. You will be asked to provide names and email addresses for each of your references in your 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 $65 non-refundable fee. IntroductionThe 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. The primary purpose of this guide is to outline policies specific to the Dairy Science Department at Virginia Tech. Policies of the Graduate School are documented in the Graduate Catalog available from the Graduate School or on-line through links via the Virginia Tech Home Page (www.dasc.vt.edu). 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 resides in Litton Reaves Hall, a modern, well equipped, office building. In addition to offices, it includes extensive laboratory and classroom facilities designed to support dairy research, teaching, and extension programs. Computing facilities are available in the building, at various campus locations, and at the University Computing Center (IBM SP2, SGI Origin 2000, Supercomputer access). The Department maintains a research and teaching herd of 150 milking cows (Holsteins and Jerseys) in a dairy center less than one mile from the office building.

Laboratories

The Department resides in Litton Reaves Hall, a modern, well equipped, office building. In addition to offices, it includes extensive laboratory with state of the art equipment and classroom facilities designed to support dairy research, teaching, and extension programs. Computing facilities are available in the building, at various campus locations, and at the University Computing Center (IBM SP2, SGI Origin 2000, Supercomputer access). The Department maintains a research and teaching herd of 150 milking cows (Holsteins and Jerseys) in a dairy center less than one mile from the office building.

Virginia Tech Dairy

The Virginia Tech Dairy Science Complex is located at Kentland Farm, encompassing 35 carefully planned acres. This state-of-the art facility is Phase 1 of a relocation plan, necessitated by expansions of the VT Airport and Corporate Research Center, as well as a new interchange on Rt. 460 at Southgate. We'll miss being close to campus, but the new Dairy Complex is a much more efficient use of land than the previous facility and it gave us the opportunity to upgrade and improve some of the technologies incorporated. The 232 milking cows are housed in a 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 heirs and close up dry cows. Additionally, there's a calf barn with automatic feeders and weaned calf pens. Of special note, our herd is currently the only one in the nation with both AFILab and Pedometer Plus systems.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: Minimum (550.0)

Computer: Minimum (213.0)

iBT: Minimum (80.0)

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 within the first 20 class days of the term and 3) have their thesis/dissertation ready for defense by the start of the semester, are eligible to request registration for 1 hour as a Defending Student (exceptions to the 20 day rule may be granted by the Graduate School). A certification form, available from the departmental office, must be submitted to the Graduate School in order to be registered as a Defending Student. Registration as a Defending Student 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 will, by March 1st of each year, write a letter which details the supervisor's evaluation of each graduate student's performance and progress toward a degree. Graduate students and faculty supervisors should 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. We have recently produced a form that serves to more clearly define guidelines and requirements. 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).To assist you and your advisor, 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 your student record in the department. The first is a DASC Graduate Student Checklist and the second is a DASC Annual Student Evaluation Form. So you will know what is expected copies of these forms are also included as the end of this document. Copies of the forms (saved as word documents) have also been sent to your major professor and to you and are available from Becky Michael as well. 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. Clearly, it is also important to keep the advisory committees informed. Remember your advisory committee is not likely to seek you out. It is your responsibility to use your advisory committee effectively. These members can provide excellent insight, perspective, and encouragement but only if you engage them. Since the evaluations occur in the Spring Semester (see above) - to meet pending graduate school requirements -- your first evaluation may well be rather brief. However, the following elements are expected to be part of your 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

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

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. 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Registration as a Defending Student 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 will, by March 1st of each year, write a letter which details the supervisor's evaluation of each graduate student's performance and progress toward a degree. Graduate students and faculty supervisors should 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. We have recently produced a form that serves to more clearly define guidelines and requirements. 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).To assist you and your advisor, 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. 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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. Clearly, it is also important to keep the advisory committees informed. Remember your advisory committee is not likely to seek you out. It is your responsibility to use your advisory committee effectively. These members can provide excellent insight, perspective, and encouragement but only if you engage them. Since the evaluations occur in the Spring Semester (see above) to meet pending graduate school requirements -- your first evaluation may well be rather brief. However, the following elements are expected to be part of your 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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

DASC 5904:

Project and Report

NONE

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

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

DASC 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

ENTOMOLOGY

Timothy Kring, Head

Professors: James Bergh; Carlyle Brewster; Timothy Kring; Thomas Kuhar; Dini Miller; Douglas Pfeiffer; Scott Salom; Peter Schultz;

Associate Professors: Sally Paulson;

Assistant Professors: Albert Auguste; Margaret Couvillon; Aaron Gross; Paul Marek; Maria Sharakhova; Sally Taylor;

Research Faculty: Roger Schuerch; James Wilson;

General Contact: kshelor@vt.edu

Graduate Site: https://www.ento.vt.edu/academic-programs.htmlic-programs.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 disseminating the results; 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 or at the The department has three major focus areas that includes: (1) Biomedical Research, with emphasis on insect genomics and urban/public health. This includes mosquito biology and vector control as they affect urban and public health, and human and animal disease; (2) Natural/Agro Ecosystems Research, with emphasis on IPM/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, Latham Hall and the Fralin Life Sciences Institute.

Price Hall

The Entomology Department is housed in Price Hall with additional on-campus laboratory facilities located in 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, Quarantine Laboratory, Genetic Stock Center, Physiology, Biochemistry and Molecular Biology labs. In addition, students and faculty have access to research facilities located at our Agricultural 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 on-line MSALS 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 is required for admission to the PhD program. PhD students are expected to demonstrate competency in their area of specialization and are required to take a minimum of 27 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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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

Instruction Type(s): Lab, Lecture

Prerequisite(s):

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): ENT 5044

Corequisite(s):

ENT 5904:

Project and Report

NONE

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

NONE

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):

ENT 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 0 TO 10

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

ENT 5994:

Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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). I,II,III

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. II

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): ENT 5114, CHEM 2535, CHEM 2536

Corequisite(s):

ENT 6164:

Insecticide Toxicology

This course is designed to teach advanced graduate students the chemistry, toxicity, mode of action, and pharmacology of insecticides and related compounds, and to give them an opportunity to learn the methods employed in studying these compounds. The course is designed for entomology and other life science majors. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s): ENT 6154

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

Instruction Type(s): Lab, Lecture

Prerequisite(s): ENT 5114

Corequisite(s):

ENT 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 0 TO 10

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

ENT 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

FOOD SCIENCE AND TECHNOLOGY

Joseph Marcy, Head

Professors: Susan Duncan; Joseph Marcy; Sean O'Keefe; Susan Sumner;

Associate Professors: Andrew Neilson; Monica Ponder; Robert Williams;

Assistant Professors: Cristina Fernandez-Fraguas; Haibo Huang; Amanda Stewart; Laura Strawn;

Research Faculty: Melissa Chase; Joell Eifert; Linda Granata; Brian Wiersema;

Adjunct Professors: Herbert Bruce;

General Contact: fstinfo@vt.edu

Student Handbook: http://www.fst.vt.edu/graduate

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

Food Science and Technology Building

The Department of Food Science and Technology is based in a separate 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 High Hydrostatic Pressure Processing Laboratory.

Human and Agricultural Biosciences Building Phase 1 (HABB1):

In 2014, the Department expanded into the new Human and Agricultural Biosciences Building 1 which 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. Researchers and graduate students will benefit from open-plan laboratories, pilot plant research space, a sensory/flavor testing suite with individual panelist booths, prep kitchens, and group debriefing and discussion rooms. Additionally, the building contains new offices for researchers and work spaces for graduate students.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (153.0), Quantitative (150.0)

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 doctoral 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

Paper: (550.0)

iBT: (80.0)

Computer: (213.0)

GRE

General: Verbal (153.0), Quantitative (150.0)

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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FST 5014:

Sensory Evaluation of Food

Principles of sensory evaluation including experimental methods, applications, and statistical analyses. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, 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 (BMVS 5094) (CHEM 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FST 5174:

Total Life Cycle Risk Management for Health Products

Application of risk management principles integrated with systems engineering concepts to product, process and support life cycles and the iterative feedback loops of information for continuous improvement to reduce risk. Design and analysis of creating a risk management system for health product manufacturers. Initiation of an integrated risk management system into the corporate environment and application of appropriate information technologies to integrate various system elements to provide an enterprise solution. Managing health product risks at product conception and thereafter.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): FST 5134, FST 5144

Corequisite(s):

FST 5404:

Food Packaging

Examines the role of food packaging in the preservation of foods in today's 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. food industry. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 5634G:

Adv Epi Food & Water Diseases

Overview of causes, transmission, and epidemiology of major environmental, food, and waterborne diseases. Outbreak and sporadic detection, source tracking, and control of pathogens. Overview of the impact of food-borne outbreaks on regulatory activites at the national and international level. Pre-requisite: Graduate Standing required

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s): FST 4504, FST 4514

Corequisite(s):

FST 5904:

Project and Report

NONE

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

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

FST 5994:

Research and Thesis

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

HUMAN NUTRITION, FOODS, AND EXERCISE

Matthew Hulver, Head

Professors: Brenda Davy; Kevin Davy; Dongmin Liu; Janet Rankin; Elena Serrano; Jay Williams;

Associate Professors: David Brown; Deborah Good; Robert Grange; Matthew Hulver; Young Ju; Eva Schmelz;

Assistant Professors: Zhiyong Cheng; Samantha Harden; Valisa Hedrick; Vivica Kraak; Carlin Rafie;

Research Assistant Professors: Madlyn Frisard;

HNFE Graduate Program: hnfegrads@vt.edu

HNFE Graduate website: http://hnfe.vt.edu/programs/graduate.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, and are 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 - obesity and 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 others of similar interests in the Departments of Biochemistry, Animal and Poultry Science, Food Science and Technology, other departments within the College of Agriculture and Life Sciences, the College of Veterinary Medicine as well as the Departments of Psychology and Human Development. 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 learn to know faculty and other graduate students who serve as informal mentors through graduate classes and attendance at Department seminars or 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 VT Riverside 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 occupies space in Wallace Hall, War Memorial Hall, the Integrated Life Sciences Building at the Corporate Research Center, and VT Riverside 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 located in VT Riverside in Roanoke conducts transformative health behaviors research with the primary objectives of prevention and treatment of life-style related diseases. VT Riverside in Roanoke houses additional space for clinical and behavioral scientists and the Fralin Translational Obesity Research Center for clinical and community research. 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

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

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 credits of which at least 20 credits are based on course work (12 credits of 5000-level or higher) and at least 6 credits of thesis research hours. The Department requires also requires MS students to complete 1 credit hour of HNFE Seminar (HNFE 5044) and 3 credit hours of statistics. 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 30 graduate credits of which at least 20 credits are based on course work (12 credits of 5000-level or higher) and at least 6 credits of thesis research hours. The Department requires also requires MS students to complete 1 credit hour of HNFE Seminar (HNFE 5044) and 3 credit hours of statistics. 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.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

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 PhD degree require a minimum of 90 credit hours of courses including research and dissertation. The minimum number of credit hours for courses numbered 5000-level or higher is 27. Research and dissertation hours must be at least 30 credit hours. The Department also requires all doctoral students to participate in graduate seminar (HNFE 5044), complete a two term departmental core course sequence, and 3 credit hours of statistics.

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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 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 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 5304:

Principles of Dietetics and Nutritional 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): 1

Lecture Hour(s): 1

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 assessment's 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 5354:

Food for Optimal Health

Diet and menu plannign and management by 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 prodution based on principles of food chemistry, human health, federal regulations, agricultural production, and environmental sustainability. Translation of food for health messages to target audiences.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, 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.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lecture, Online Lecture
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): HNFE 5174G
Corequisite(s): HNFE 5126G

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): Lecture, Online Lecture
Instruction Type(s): Lecture, 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 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
Instruction Type(s): Lecture
Prerequisite(s): HNFE 4624, HNFE 5654
Corequisite(s):

HNFE 5674:
Principles of Community Health Education
Social determinants of health (SDOH), including social class, poverty, education, race, social networks, workplace or occupation, and neighborhood environments relevant to obesity and obesity-related chronic diseases. Study design, measurement of SDOH and hypothesis testing using SDOH frameworks. Pre: Graduate Standing.
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): null null
Corequisite(s):

HNFE 5694 (PHS 5044):
Public Health Administration
This course will focus on relevant and timely public health administration concepts. The major topics covered include: health policy, health care planning, health care economics, health law, and managerial functions as they relate to health care and public health settings. 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):

HNFE 5724:

Epidemiology

Epidemiology is the study of the distribution and determinants of the varying rates of diseases, injuries, or other health states in human and animal populations. This course consists of an introduction to epidemiological terminology, concepts and research methodology. 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):

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

HNFE 5764:

Externship in Human Nutrition and Foods

Special interdisciplinary problem-solving clinics for experienced health practioners 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
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

HNFE 5804:

Research Design in Exercise Science

Molecular and cellular mechanisms underlying physiological adaptations to actue 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

NONE

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 5964:

Field Work/Practicum

NONE

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

NONE

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

HNFE 5984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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:

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: Gradaute standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

HNFE 6984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

HNFE 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

PLANT PATHOLOGY, PHYSIOLOGY, AND WEED SCIENCE

Boris Vinatzer, Interim Head

Emeriti Faculty: Edward Hagood; Sue Tolin;

Professors: Jeffrey Derr; Jonathan Eisenback; Elizabeth Grabau; Ruth Grene; Chuanxue Hong; Charles Johnson; David Langston; John McDowell; David Schmale; Boris Vinatzer; James Westwood; Keith Yoder;

Associate Professors: Shawn Askew; Maria Balota; Jacob Barney; Antonius Baudoin; Eva Colla'kova'; John Jelesko; Guillaume Pilot; Steven Rideout;

Assistant Professors: Michael Flessner; David Haak; David McCall; Hillary Mehl; Mizuho Nita;

Research Faculty: Elizabeth Bush; So Yon Park;

Instructors: Mary Hansen;

General Contact: cris75@vt.edu

Graduate Site: http://www.ppws.vt.edu/

The core mission of Department of Plant Pathology, Physiology and Weed Science (PPWS) 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 Department offers a Ph.D. degree in several areas of concentration within the department: 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. Finally, the Department participates actively in several interdepartmental programs such as the Molecular Cell Biology and Biotechnology Program, Genetics, Bioinformatics, and Computational Biology program, the Molecular Plant

Sciences program, and numerous international programs.

SPECIAL FACILITIES

PPWS facilities are located on-campus (Blacksburg) and at the Virginia Agricultural and Extension Centers (ARECs), including: Price Hall (main office), 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

Latham Hall

Price Hall

Price Hall

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

Doctoral degree: PPWS offers the Ph.D. degree in any of the departmental concentrations. 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 5004:

Seminar

Review, discussion, invention, analysis, and synthesis of principles and concepts in plant pathology, plant physiology, and weed science. May be repeated. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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. I

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab

Instruction Type(s): Lab

Prerequisite(s): , PPWS 4754

Corequisite(s):

PPWS 5044:

Plant Bioengineering and Bioregulation

Worldwide impact of biotechnology applied to plants, animals, and microorganisms. Concepts, scientific and ethical issues, and public concerns related to genetic engineering. Safety and release of genetically engineered organisms; bioremediation; cloning, transgenic plants, animals, and microbes. Graduate Standing required. Two semesters each of biology and chemistry.

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 5054:

Plant Pathogenic Agents

Biology of plant pathogenic fungi, prokaryotes, viruses, and nematoads: 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

PPWS 5064 (BIOL 5064) (ALS 5064) (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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): 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. I

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 5304:

Plant Stress Physiology

Analysis of physiological responses of agricultural and native plants to environmental stresses such as extremes of temperature, availability of water and nutrients, and presence of air pollutants. Emphasis on linking stress caused changes in carbon gain, water loss, nutrient utilization, and energy balance with changes in growth. Laboratory to introduce equipment and research approaches used in greenhouse and field studies. II

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture

Instruction Type(s): Lab, Lecture

Prerequisite(s):

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

Instruction Type(s): 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 host's and pathogen's physiology and biochemistry in disease susceptibility and resistance, recognition, and disease specificity. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5524 (HORT 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

Instruction Type(s): 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 politcal 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

Instruction Type(s): Lab, Lecture

Prerequisite(s):

Corequisite(s):

PPWS 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): PPWS 5044

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 Master's degree, who have completed all other course work. I,II,III

Credit Hour(s): 3

Lecture Hour(s): 0

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PPWS 5904:

Project and Report

For students pursuing a non-thesis Master's degree. Projects may involve guided research or an internship. I,II,III

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

NONE

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

NONE

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

NONE

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. I,II

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PPWS 6984:

Special Study

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

GOVERNMENT AND INTERNATIONAL AFFAIRS

Giselle Datz, Chair

Professors: Timothy Luke; Joel Peters; Joyce Rothschild; Gerard Toal;

Associate Professors: Ariel Ahram; Giselle Datz;

Affiliated Faculty: Matthew Dull; Ilja Luciak; Randall Murch; David Orden;

Georgeta Pourchot; Ioannis Stivachtis; Edward Weisband; Kris Wernstedt;

General Contact: mlechuga@vt.edu

General Contact: jhudson@vt.edu

Graduate Contact: gdatz@vt.edu

Graduate Site: https://www.gia.vt.edu

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

Contact Myriam Lechuga or Julie Hudson at National Capital Region Center for more information.mlechuga@vt.edu or 703-706-8111jmhudson@vt.edu or 703-706-8105

Printing/scanning services

For information on facilities, please contact Myriam Lechuga or Julie Hudson for further details.

DEGREES OFFERED

MPIA Degree

Offered In (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 (Major Paper or Practicum)* Option5000-6000 level courses 33 credit hours5904 Project & Report 3 credit hoursThesis Option5000-6000 level courses 30 credit hours5994 Research & Thesis 6 credit hoursTotal Hours for all capstone Option: 36[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:

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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):

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 5164:

Collaborative Governance and Civil Society

Theoretical foundations of collaborative policy and governance approaches are examined. Strategies and methods for forming and sustaining collaborative coalitions are discussed. Case studies are used to illustrate the effectiveness of collaborative approaches in different policy domains. 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):

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:

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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

Instruction Type(s): 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 (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):

GIA 5364 (PSCI 5364):

Public Ecology

Examines policy developments and practices that move beyond the conceptual divisions and policy operations begun during the 1970's, 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:

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:

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:

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 People's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

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):

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 global affairs. Prereqs or instructor's 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 (PSCI 5504) (UAP 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 techniqeus 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): GIA 5444 OR PSCI 5444 OR UAP 5264
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 5534:
Regionalism and Political Development
Provides a systematic review of regional organizations, the theories and factors that explain their recent emergence and an analytical framework for studying regional policy objectives such as peace and security, economic growth, environmental protection and the pursuit of human rights. Regional variations between Europe, Latin America, Asia, Africa and the Middle East are examined.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): GIA 5444 OR PSCI 5444
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

Feminst 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 feminst controversies and women's transnational resistance.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

GIA 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):

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):

GIA 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):

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: Greaduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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 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 student's 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): GIA 5014, GIA 5214 OR UAP 5144
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. Pre-requisite: Graduate Standing and enrollment in Masters Internation Program and Peace Corps.
Credit Hour(s): 6
Lecture Hour(s): 6
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s):
Corequisite(s):

GIA 5964:

Field Work/Practicum

NONE
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

NONE
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

NONE
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

NONE
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research
Instruction Type(s): Research
Prerequisite(s):
Corequisite(s):

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.
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 (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): 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
Instruction Type(s): 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
Instruction Type(s): Lecture
Prerequisite(s): GIA 5034 OR UAP 5034 OR PSCI 5034
Corequisite(s):

GIA 6204:

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. Pre-requiste may be substituted for any equivalent 5000 level international course.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): UAP 5264 OR GIA 5264
Corequisite(s):

GIA 6214:

Democracy Beyond the Ballot

Forms of ultra or enhanced democracy outside of state institutions, particulary 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
Instruction Type(s): Lecture
Prerequisite(s): GIA 5034 OR UAP 5034 OR PAPA 5034 OR GIA 5164 OR UAP 5164
Corequisite(s):

GIA 6224:

Competing Conceptions of the Third Sector

Competing theories and conceptions of the third sector in relation to the for-profit firm and the state with international perspectives on voluntary grassroots action challenges and societal transformation. Integration of theoretical and research literatures in the field. Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture
Instruction Type(s): Lecture
Prerequisite(s): GIA 5034 OR UAP 5034 OR PAPA 5034 OR GIA 5164 OR UAP 5164
Corequisite(s):

GIA 6984:

Special Study

NONE
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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

FOREST PRODUCTS

Audrey Zink-Sharp, Associate Head
Robert Smith, Head

Professors: Robert Bush; Kevin Edgar; Charles Frazier; A Hammett; David Kline; Joseph Loferski; Robert Smith; Paul Winistorfer; Audrey Zink-Sharp;

Associate Professors: Daniel Hindman; Henry Quesada; Maren Roman;

Assistant Professors: Laszlo Horvath; Young Kim;

General Contact: garnandd@vt.edu

The Department of Sustainable Biomaterials is one of the leading academic programs in North America. We support a large graduate education program where students are engaged in research. Because of the nature of sustainable biomaterials, we have considerable interaction in our graduate education and research endeavors with other departments, colleges, centers and institutes on the Virginia Tech campus. Our faculty expertise is diverse and experienced in support of our graduate education mission. We provide educational and research opportunities in the areas of sustainable biomaterials, spanning the range from nanotechnology and the basic science of wood and other renewable materials, through processing, manufacturing, marketing, management, and competitiveness aspects of the various biomaterials industries. Some of our research is done in concert with our faculty-directed research centers and is supported by these Centers and their external cooperators. General areas of degree specialization within our graduate program include: Forest Products Marketing, Non-Timber Forest Products, Packaging Science, Pallet and Container Design, Wood Engineering, Wood Performance in Structures, Composites, Adhesion, Wood Formation, Cell Wall Architecture, Bio-Materials, Lumber Drying and Processing, Lean Manufacturing, Wood Industry Management, Packaging for Modern Supply Chains, Packaging and Unit Load Design

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, 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.

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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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

Instruction Type(s): 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

Instruction Type(s): Lab, 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

Instruction Type(s): Lab, 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

Instruction Type(s): Lecture

Prerequisite(s): null null

Corequisite(s):

SBIO 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s): (CHEM 2565 (UG) OR CHEM 2565), (CHEM 2566 (UG) OR CHEM 2566) OR (CHEM 2514 (UG) OR CHEM 2514)

Corequisite(s):

SBIO 5424G:

Adv Polysaccharide Chemistry

Structure, propertis, 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

Instruction Type(s): Lecture

Prerequisite(s): SBIO 4614 OR FREC 3424

Corequisite(s):

SBIO 5894:

Final Examination

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SBIO 5954:

Study Abroad

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

SBIO 5974:

Independent Study

NONE

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

NONE

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

NONE

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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

BIO-INSPIRED BUILDINGS

Professors: Virginia Buechner-Maxwell; Ignacio Moore;

Associate Professors: Susan Day; Deborah Dickerson; Michael Garvin; Rolf Mueller; Annie Pearce; Georg Reichard;

Assistant Professors: Jonathan Boreyko; Farrokh Jazizadeh Karimi; Earl Shealy;

General Contact: howardl@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 bio-inspiration and bio-integration provide paths towards this objective. A bio-inspired built environment capitalizes on the regulative, adaptive, and integrative characteristics of biological systems and incorporates these features into the constructed world. Likewise, a bio-integrated built environment situates constructed facilities amidst natural systems to achieve symbiosis. 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 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, CNRE, COE and COS to deliver a program that explores the built environment and biological systems synergistically to discover innovative connections between these two fields. BioBuild Fellows can receive from 12 to 36 months of financial support from the program while working toward a degree in one of the departments listed below. To receive a preliminary assessment of your fit with this program, please submit a form of intent through our web-site. 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 Core Faculty: College of Architecture & Urban Studies Myers-Lawson School of Construction - Deb Dickerson Building Construction - Annie Pearce, Georg Reichard College of Science Biological Sciences - Bryan Brown, Ignacio MooreCollege of Engineering Mechanical Engineering - Rolf Mueller Civil and Environmental Engineering - Michael Garvin, Tripp Shealy College of Natural Resources and Environment Forest Resources and Environmental Conservation - Susan Day For more information please contact Dr. Michael Garvin at garvin@vt.edu or Lora Howard at howardl@vt.edu. Visit our web-site at biobuild.mlsoc.vt.edu.

SPECIAL FACILITIES

Our program involves multiple colleges and departments so facilities from across campus are utilized to support the program. The program is headquartered in Bishop-Favrao Hall, which was opened in 2007 and includes state-of-the-art classrooms, meetings 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, and Patton Hall which are homes to the Department of Biological Sciences, the Department of Mechanical Engineering and the Via Department of Civil & Environmental Engineering respectively.

Facilities

This is an interdisciplinary program and shares facilities among departments across campus. Facilities are located in Bishop-Favrao Hall, Derring Hall, Goodwin Hall and Patton Hall.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

Students in the Bio-inspired Buildings (BioBuild) program earn a degree from one of the participating degree-granting programs. Please see a list of current participating programs in the Program Overview and visit the program of interest in the Graduate Catalog to review the relevant requirements.

BUSINESS, EXECUTIVE BUSINESS RESEARCH

Parviz Ghandforoush, Head

Professors: Kevin Carlson; Raman Kumar; Christopher Zobel;

Associate Professors: Daniel Beal; Sudip Bhattacharjee;

Assistant Professors: David Townsend;

Konrad W. Kubin Jr. Faculty Fellow: Sudip Bhattacharjee;

R. B. Pamplin Professor: Christopher Zobel;

R.V. & A.F. Oliver Professor of Investment Management: Raman Kumar;

General Contact: jmjacks@vt.edu

Graduate Site: http://www.pamplin.vt.edu/academic/phd-programs/executive-phd/

Launched in fall 2016 by Virginia Tech's Pamplin College of Business, BXBR is a new concentration within the Ph.D. Program in Business. The BXBR concentration is designed specifically to serve experienced executives seeking the advanced knowledge and skills needed to conduct high quality research on emerging business issues. Tailored for high-ability working professionals, this three-year part-time program provides students with an in-depth understanding of the scholarly literature in their chosen business discipline, rigorous training in relevant analytical research techniques, as well as experience in conducting high quality original research embodied in a dissertation addressing a complex business problem. The program promotes inter-disciplinary research, encourages collaborative research with faculty and other doctoral students, and aims to qualify graduates for careers that rely on advanced research skills - as full-time academics in university business schools, or as high level professionals in business and government.

SPECIAL FACILITIES

The Ph.D. in Business: Concentration in Executive Business Research, Evening MBA and the M.S. in business administration, hospitality, and tourism management are 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 next to the West Falls Church Metro station on the Orange line.

Northern Virginia Center

The Ph.D. Program classes are held in the Northern Virginia Center in Falls Church at 7054 Haycock Road, just across from the West Falls Church metro station, and near Route 7, I-66 and I-495.

DEGREES OFFERED

PhD Degree

Offered In (National Capital Region)

TOEFL

Paper: (550.0)

iBT: (80.0)

Credit Requirements: The Virginia Tech Ph.D. in Business requires a minimum of 90 credit hours. The three year program for the Concentration in Executive Business research assumes prior graduate study in business or a related field from which a relevant 30 credits may be transferred to meet core credit requirements. Candidates who do not have this preparation must complete additional 30 credits of preparatory work. The remaining 60 credits are completed via 30 credits of graded coursework (four content seminars, five methodology seminars and a pro-seminar) and 30 dissertation and research credits. Graded Coursework: The graded coursework is tailored to the student's primary disciplinary interest (offered in the Pamplin departments Accounting and Information Systems, Business Information Technology, Hospitality and Tourism Management Finance, Marketing and Management) and will be taken during the fall and spring semesters. The first two disciplinary content seminars will parallel closely those taken by traditional full-time Ph.D. students. The two remaining content seminars will provide additional disciplinary depth or interdisciplinary content tuned to the student's research interests. These courses meet on weekdays or Friday afternoons to allow executive Ph.D. students to participate synchronously with traditional doctoral students in live technology-aided discussions. The five methodology seminars are scheduled for synchronous sessions on weekday evenings or Saturday mornings. During the residential sessions (every other week) students have access to faculty/tutors to review the work done during the preceding two weeks and to preview upcoming sessions. Each course is worth 3 credits - the pro-seminar is delivered during the winter intersessions (Year1: 2 credits; Year 2: 1 credit). The fall and spring terms during years 1 and 2 employ a hybrid delivery format. Classes meet each week, with every other week being a residential session held at Virginia Tech's Northern Virginia campus, and occasionally in Blacksburg. The residential sessions help the Executive Ph.D. student assimilate into the Pamplin School's academic community and encourage face-to face and technology-aided interactions with faculty as well as peers in the full-time doctoral programs. During each residency, Friday post-dinner sessions feature research seminars by academic and industry thought-leaders. Research: Students register for graded research credits during the summer of year 1. This 3-credit course aims to stimulate the students thinking about specific research problems and developing an original research proposal that blends their formal training and business experience. During year 2, students develop this (or an alternative idea) into a formal research study as a 3-credit course. They also take a 4-credit course in which they prepare their dissertation research proposal and defend it by the end of the second year summer term. Each of these research courses are taken under the guidance of a faculty committee of mentors selected at the start of Year 2. During Year 3, each student conducts dissertation research under the close supervision of the dissertation committee. Although there is no stipulated formal interaction in these phase of the program, students are strongly advised to stay in close touch with their committee both to keep them informed of research progress and also to receive on-going guidance. This process is expected to culminate in the successful dissertation by the end of the summer term of the third year or shortly thereafter. Each student has the opportunity to gain on-line or face-to-face classroom teaching experience in one of Pamplin's undergraduate or graduate programs. This preparation provides the pedagogical skills integral to a doctoral degree and will be financially compensated.

COMPUTATIONAL TISSUE ENGINEERING

Padmavathy Rajagopalan, Program Director

Dr. Padma Rajagopalan: padmar@vt.edu

Graduate Site: http://cte.cs.vt.edu/about-cte

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 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 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.

CREATIVE TECHNOLOGIES

Kevin Concannon, Head

Professors: Kevin Concannon;

Associate Professors: Eric Standley; Thomas Tucker;

Assistant Professors: Samuel Blanchard; Meaghan Dee; Travis Head; Rachel Weaver;

Affiliated Faculty: Ivica Bukvic; Richard Knapp;

General Contact: rcallah@vt.edu

Graduate Contact: thomasjt@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 in the School of Visual Arts (SOVA) is a professional, terminal degree program that prepares students to use digital and new media technologies to create, present, communicate and shape information and imagery. Primary emphasis is in animation, interactivity, and visualization (spatial, data, etc). The program addresses emerging trends in the use of these tools in scientific and research arenas, art and design, and industrial/commercial contexts. Based in visual arts and design, the Creative Technologies program is cross-disciplinary and inter-media. Faculty work with students on an individual basis to design a unique program of study and research which culminates in a thesis project. Students integrate original work across a spectrum of modalities, including 3D animation, motion graphics, digital imaging and video/audio, interactive environments, and creative coding. The MFA program connects students with faculty, research, and courses not only in SOVA but also in Computer Science, Music, Engineering, Human Centered Design, and a host of other programs at the intersection of arts, design, engineering, sciences, and cultural issues. We are integrally related to the projects and faculty of the Institute for Creativity, Arts, and Technology. MFA students in SOVA build unique connections with technology-based faculty in art and design that bridge out to the larger community of creative researchers, educators, and commercial/industrial practitioners. On average, the full time student will complete the program in two and half to three years. Students entering with significant prior experience in their chosen areas and with a strong digital design background may be able to complete the program in two years. Application DeadlinesThere are two application deadlines for the MFA CT program: October 14th for students enrolling for the Spring semester and February 13th for students enrolling for the Fall semester.

Please go to the MFA in Creative Technologies website for more info and here for a pdf with specific instructions.

SPECIAL FACILITIES

The School of Visual Arts Studios are located in several different buildings.Designated Graduate Research Space is provided for MFA students in the SOVA Studios.The Art Armory is home to the school's main office, gallery, and studios for Drawing and the Foundations Program. One of Blacksburg's historic buildings and a former community gymnasium, it is situated on Draper Road, 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 (national and regional), faculty, and students. XYZ Gallery, located at 221 N. Main St., is home to the Student Art Association, which operates an independent program of exhibitions by students and local artists.DAAS LabA core facility for MFA students is the Digital Arts and Animation Lab (DAAS), centrally located on the first floor of the Newman Library. DAAS provides students with the high-end tools used throughout industry in the production of digital film, motion graphics, interactive media, and animation content. The lab contains 10 Mac Pro workstations with large 24-30 inch monitors and 10 iMacs, all loaded with professional industry applications, including Maya, ZBrush, Max/MSP/Jitter and Adobe Creative Suite.Henderson Hall houses the Visual Communication Design program (undergraduate) and Art History, as well as a studio for certain creative technologies courses. Four Design (SOVA's professional internship program for undergraduates) and GlyphX (SOVA's professional printing service center) are located in Henderson.The Art & Design Learning Center (ADLC) is the location for SOVA studios in Painting, Sculpture, and Ceramics. The Sculpture studio maintains a strong focus on digital fabrication/prototyping and also includes a full wood shop.Equipment and Tools for creative projects based in digital technologies include: FARO Focus 3D Laser Scanner Shopbot 96"x48" CNC Router Makerbot Replicator OptiTrack Motion Capture System (through ICAT) 2 Universal Laser Systems 18"x32" Laser Cutter Digital SLR and Video Cameras Digital Recorders Midi controllers Small electronics, sensors, microcontrollers College-level facilities include the Art + Architecture Library in Cowgill Hall. SOVA facilities and equipment are augmented by the diverse array of spaces and equipment available to MFA students for research projects through ICAT. These include the "Living Labs," a group of distinctive spaces equipped and dedicated to innovative experimental inter-media arts and research projects: The Cube, Experience Studio, Sandbox, Merryman Family Learning Studio, Perform Studio, and Create Studio. MFA students have access to Innovation Space in Torgersen Hall, a well equipped public digital laboratory for video and audio editing, as well as a source for short term, free use of high end cameras, audio kits, and other equipment.

Facility Web Resources

Links to some SOVA facilities and to related centers.

DEGREES OFFERED

MFA Degree

Offered In (Blacksburg)

IELTS
TOEFL

Paper: (550.0)

iBT: (80.0)

The MFA in Creative Technologies requires 60 graduate credit hours, including a thesis project. The credit hours are distributed as follows: 30 credit hours in digital studios, projects, labs, and internships 9 in art history / theory courses, including graduate seminar 9 in electives outside of the School of Visual Arts 12 in thesis project, culminating in a public event, exhibition, app, or other mode appropriate to the project. Professional internships are strongly encouraged and up to 12 credit hours of studio / lab may be used for well designed internships on or off campus. In addition to the 60 credit hours students may be required to take certain courses to strengthen their background in specific areas, as determined by the MFA faculty. These courses do not count toward the 60 hour Plan of Study, but do count toward full time status and graduate assistantships.

Degree Concentrations:

While we do not have pre-defined curricular tracks students can develop their Plan of Study to concentrate in data and spatial visualization; creative coding for art and design; 3d animation and gaming; and interactive envrionments. Most students will combine elements of each of these as they develop a path that is uniquely tailored to their interests and goals.

DATA ANALYSIS AND APPLIED STATISTICS

Ronald Fricker, Head

Professors: Ronald Fricker; Robert Gramacy; David Higdon; Ina Hoeschele; Sallie Keller; John Morgan; Sally Morton; Eric Smith; Gordon Vining; William Woodall;

Associate Professors: Xinwei Deng; Pang Du; Marco Ferreira; Feng Guo; Yili Hong; Leanna House; Inyoung Kim; Scott Leman; George Terrell;

Assistant Professors: Christopher Franck; Leah Johnson; Shyam Ranganathan; Srijan Sengupta; Xiaowei Wu;

Associate Professor of Practice: Jennifer Van Mullekom;

Research Assistant Professors: Allison Tegge;

Graduate Contact: adriscoll@vt.edu

General Contact: chconne1@vt.edu

Graduate Site: https://www.stat.vt.edu/Academics/graduate/ma-curriculum.html

The Master of Arts in Data Analysis and Applied Statistics is offered by Virginia Tech’s Department of Statistics. The degree is also sponsored by other programs and departments including the Education Research and Evaluation Program (EDRE), the Departments of Psychology, Fish and Wildlife Conservation, Forest Resources and Environmental Conservation, Geography, Economics, Human Development, Sociology, Psychology, Biological Sciences, and the Genetics, Bioinformatics, and Computational Biology program. The curriculum provides a broad variety of applied statistical tools to students, without the emphasis on statistical theory steeped in mathematics. The M.A. DAAS degree is structured so that certain courses that emphasize the fundamentals of statistics, are required. Electives in specialized topics in statistics are then chosen by the student. Thus, the degree offers sufficient depth in the fundamentals of contemporary applied statistical methods and gives students an understanding of how these methods are applied in different fields.Students seeking admission to the M.A. DAAS degree are those wishing to expand their statistical knowledge beyond the material presented in graduate service courses, tackling more specialized topics, whether they are taught statistical methodology by the Department of Statistics or by other programs/departments on campus. The M.A. DAAS degree is offered as 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.

SPECIAL FACILITIES

Department of Statistics

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

MADAS Degree

Offered In (Blacksburg)

GRE

General: Quantitative (150.0)

TOEFL

Paper: (577.0)

iBT: (90.0)

The program requires 33 credit hours of coursework (21 hours from the core and 12 hours of electives). The core requirements will be based on courses from four topic areas: Data Analysis, Design of Experiments or Study Design, Regression Analysis, and Statistical Theory, and also a professional development course in consulting. Below is a list of the core courses: STAT 5615: Statistics in Research I STAT 5616: Statistics in Research II STAT 5204G: Experimental Design: Concepts and Application STAT 5214G: Advanced Methods of Regression Analysis STAT 5105G: Theoretical Statistics STAT 5024: Effective Communication in Statistical Consulting STAT 5904: Project and Report

DISASTER RESILIENCE

Professors: Jennifer Irish; Christopher Zobel;

Associate Professors: Margaret Cowell; Robert Weiss; 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) 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

Offered In (Blacksburg, National Capital Region)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

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)

HIGHER EDUCATION

Claire Robbins, Program Director

Emeriti Faculty: Joan Hirt;

Assistant Professors: Claire Robbins;

Affiliated Faculty: Sharrika Adams; Catherine Amelink; John Dooley; Martha Glass; Roderick Hall; Michael Herndon; Patricia Hyer; David Knight; David Kniola; James Orr; Patricia Perillo; Ellen Plummer; Menah Pratt-Clarke; Donna Ratcliffe; Karen Sanders; Susan Short; Frank Shushok; Kimberly Smith; Kenneth Smith; Edward Spencer; Sherwood Wilson;

General Contact: nanboden@vt.edu

Higher Education: http://www.soe.vt.edu/highered/

Program Leader: Gabriel R. Serna (gaserna@vt.edu, 1750 Kraft Dr #2007, 540-231-9700) Graduate Program Director: Nancy Bodenhorn, (nanboden@vt.edu, 101 War Memorial Hall, 540-231-8180) Web site: http://www.soe.vt.edu/highered/ Comprehensive Programs, Designed to Prepare Higher Education Leaders for the Challenges of Tomorrow. Graduate professional education is concerned with enhancing a broad spectrum of talents in students. Some of these talents are addressed by structured, in-class activities determined primarily by faculty, while others are addressed by out-of-class activities that often are student-directed. Both types of learning opportunities are incorporated into each student's Plan of Study. The Higher Education program at Virginia Tech is built upon collegial relationships between faculty and students throughout the period of graduate study with a special emphasis on social justice and equity. Faculty serve as teachers, advisors, colleagues, and mentors to students. For full consideration all application materials must be received by January 15th of each year. The program does not participate in rolling admissions. Highlights of the Program: Professional and scholarly development in higher education policy and leadership Extensive professor and student interaction Opportunities for student scholarship and research Funding availability for both master's and doctoral students Part-time enrollment for working professionals The Higher Education program affirms the Virginia Tech Principles of Community and strives to incorporate these principals into our programming. Furthermore, the program is committed to increasing diversity on campus through recruitment and retention of qualified faculty, staff and students and it supports policies, programs and practices needed to maintain this effort. For more information, please visit www.multicultural.vt.edu. Degree Requirements: The Higher Education program offers degrees on the Blacksburg campus only. The M.A.Ed. is a 48-hour program and an e-Portfolio is required. The Ph.D. is a 96-hour program and a dissertation is required. Please see the Higher Education web site for specific requirements for all degrees.

SPECIAL FACILITIES

DEGREES OFFERED

MAEd Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (213.0)

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: (550.0)

iBT: (213.0)

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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5106:

Assessment in Higher Education Administration

NONE

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5404:

Staffing Practices in Higher Education

Study of human resource management in education. Emphasis on recruitment and selection, orientation, supervision, staff development, performance appraisal, and separation. Application of a human resource development perspective guides research and assessment of current and future practices. Pre: Graduate standing.

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

NONE

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):

EDHE 5984:

Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDHE 5994:

Research and Thesis

NONE

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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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

Instruction Type(s): 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 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

Instruction Type(s): 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 6424:

Institutional Effectiveness and Outcome Assessment in Higher Education

Study of institutional conditions that determine effectiveness including effects of institutions on student learning and personal development. Includes assessment of general education, the academic major, affective student learning, retention, employment suitability, and other aspects of student life related to teaching and learning.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDHE 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

Instruction Type(s): 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

EDHE 7994:

Research and Dissertation

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): Research

Prerequisite(s):

Corequisite(s):

HUMAN CENTERED DESIGN

Steven Harrison, Program Director

Associate Professors: Matthew Wisnioski;

Associate Professor of Practice: Steven Harrison;

General Contact: srh@vt.edu

Graduate Site: http://www.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 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. 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-oriented, rather than a product-oriented, attitude towards education. HCD at VT is both a PhD program and a graduate certificate in a curriculum that combines technical expertise with critical inquiry to develop reflective practitioners equipped to meet vital human needs. 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. Faculty currently associated with the HCD program are from these Colleges and Departments: 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) For more information please contact Steve Harrison at srh@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.

CHCI

CHCI: The Center for Human-Computer Interaction The Center for Human-Computer Interaction 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), 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.

DAAS

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

DISIS: Digital Interactive Sound and Intermedia Studio

DISIS complements and recontextualizes the Virginia Tech music technology program by providing the rapidly growing Creative Technologies in Composition and Multimedia Art Design option. 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 Center for the Arts' facilities provide a community center in the grandest sense, a place where the arts are a catalyst for engagement, inspiration, and discovery. 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 four-story experimental "Cube" for performance, immersive environments, installation, and adjacent research studios. Prototyping and mulitmedia studios provide resources for material exploration and performance.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

All Individualized Interdisciplinary PhD (IPhD) degree students will meet all requirements for doctoral study at Virginia Tech. 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 ID PhD 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' individual plans of study are developed in consultation with their major professor and advisory committee members and approved by the Graduate School. 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.

Degree Concentrations:

Core Areas of Study

Although an official concentration is not offered, students choose from one of three Core Areas of study comprising several different disciplines. See the graduate program website for current approved Core Area of Study approved cognate courses.

INDIVIDUAL INTERDISCIPLINARY PHD

Karen DePauw, Head

Karen DePauw: kpdpauw@vt.edu

General Contact: wrhuckle@vt.edu

Interdisciplinary graduate Education:

http://interdisciplinary.graduateschool.vt.edu

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 be met by a single discipline from a 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. The IPhD program is intended for doctoral training requiring participation, collaboration, and integration from two or more academic units representing different disciplines.

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 in the Graduate Life Center. Additional facilities will be available to IPhD students depending on those available to the advisory committee members.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

For successful admission to and completion of the individualized interdisciplinary PhD (IPhD) program at Virginia Tech, the student must demonstrate the need for the interdisciplinary research dissertation and identify a major professor and advisory committee members who will provide the appropriate guidance. A prospective student who wishes to pursue the IPhD degree must be near completion or have completed a master's degree. Prospective students without a master's degree may be approved by the Vice President and Dean of the Graduate School to submit an application under special circumstances. Because of the rigor and intensity of the ID PhD program, a graduate GPA of 3.5 or higher is required. The Graduate School will administer the IPhD program for highly motivated students in excellent academic standing whose primary education and research goals are truly interdisciplinary such that no single discipline or degree granting unit can accommodate the students' scholarly pursuits. The IPhD program is specifically designed for students who will seek to study across two or more disciplines in a combination not available through a degree granting program. Like all doctoral students, the IPhD students will be closely supervised by the major professor and at least three advisory committee members. Admission to the IPhD is highly selective because the Graduate School will expect completion of an especially rigorous set of courses and dissertation research project for this degree. Students currently enrolled in a graduate degree program at Virginia Tech who are interested in IPhD are encouraged to apply as early as possible in their program, to maximize the duration of their unique interdisciplinary training experience. For these students, the composition of the advisory committee should reflect the particular academic disciplines and realms of expertise being bridged by the IPhD, but typically stems from the student's original programmatic affiliation(s). 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. In identifying potential advisors and areas of study, prospective IPhD students may elect to apply for a unique degree focus, or may affiliate with faculty participants in an existing Interdisciplinary Graduate Education Program (IGEP). All prospective IPhD students will prepare their application, including a program of study and dissertation proposal, in consultation with the major advisor and advisory committee members. Formal application for admission to the IPhD program is made to the Graduate School. Interested applicants 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. Applications to the IPhD are evaluated on a rolling basis, and new admissions can start in Fall, Spring, or Summer terms. The Commission on Graduate Studies and Policies (CGS&P) serves as the admissions committee and is available to review applications twice monthly throughout the academic year. Applicable materials include the following: If required by any of the academic units with which the student will be working, the results of standardized tests such as GRE or GMAT. International students must submit acceptable TOEFL (iBT = 80 total and 20 on each subtest) or IELTS (6.5) scores or otherwise 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 VT faculty 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 3-4 tenure-track VT faculty members willing 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 of no more than 20 pages that includes the following components: Proposed interdisciplinary degree program title. Advisor and list of advisory committee members, including rationale for their inclusion on the committee and identification of areas of expertise relevant to the proposed research program. Completed and current coursework (transcripts). Coursework plan of study for the IPhD degree. 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 rationale for each course should be included. Career goals and personal motivation for pursuing an IPhD A description of the format and content of the preliminary examination, including topic areas to be covered from various disciplines involved. Detailed timeline from enrollment to graduation. A brief description of the interdisciplinary degree proposal, including an overview of the research topic and the final product that will be the outcome of the IPhD. The proposal should be written with a general, interdisciplinary academic audience in mind. A short literature review along with a summary of objectives or anticipated products must be included. The description should make the case: 1) that the proposed project is truly scholarly in nature (i.e., worthy of a PhD dissertation) and 2) that the proposed dissertation can only be accomplished from an interdisciplinary standpoint. 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 scholarships and fellowships from VT or external sources.

INTERFACES OF GLOBAL CHANGE

Dr. William Hopkins, Director: hopkinsw@vt.edu

Dr. Bruce Hull, Committee Chair: hullrb@vt.edu

Ms. Jessica Zielske, Program Coordinator: jcoker@vt.edu

Program Website: http://www.globalchange.vt.edu/igc/

The five greatest anthropogenic threats to global health and biodiversity include habitat loss, pollution, climate change, disease, and the introduction of non-native species. Although there is considerable research on each of these individual global threats, much less is known regarding how these factors interact with one another. For example, how can climate change affect the distribution of invasive species that are important vectors of disease? These types of interactions are critical because all habitats experience the simultaneous pressure of two or more of these threats. Looking to the future, a more interdisciplinary understanding of these anthropogenic factors is necessary to inform public policy, minimize further environmental degradation and loss of biodiversity, and to promote sustainable solutions to the greatest environmental challenges of the 21st century. The Interfaces of Global Change (IGC) program is an 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) on campus that address a major fundamental problem or complex societal issue requiring an interdisciplinary team of scholars. Participants (PhD Fellows) will enter the program at the beginning of their graduate studies and continue to participate throughout their time at Virginia Tech. The goals of the IGC IGEP are to provide each PhD Fellow with a broad perspective on: How the five major global changes interact to impact biodiversity and environmental health The societal causes and consequences of these ecological problems The role that science can play in resolving these issues by informing sound environmental policy The Interfaces of Global Change IGEP is not a degree-granting program. Rather, it will provide PhD students with a unique intellectual focus and training. Our goal is for each IGC Fellow to gain depth in their specific scientific area of expertise (e.g. biology or engineering), while simultaneously gaining breadth in the multifaceted realm of global change and the science-policy interface. Students still receive their PhD degree from their home department, but they will participate in a slightly different curriculum that will focus on global change. 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 17 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 Departments College of Agriculture and Life Sciences Entomology Plant Pathology, Physiology & Weed Science Crop & Soil Environmental Sciences Horticulture College of Engineering Biological Systems Engineering Civil and Environmental Engineering College of Liberal Arts and Human Sciences Department of History College of Natural Resources and Environment Fish & Wildlife Conservation Forest Resources and Environmental Conservation Geography Virginia Water Resources Research Center College of Science Biological Sciences Geosciences Statistics College of Architecture and Urban Studies School of Public and International Affairs College of Business Business Information Technology College of Veterinary Medicine Department of Population Health Sciences For more information, contact the program coordinator, Gloria Schoenholtz schoeng@vt.edu, or the principal investigators, Dr. Jeffrey Walters jrwalt@vt.edu (P.I) or Dr. Bruce Hull (Co-P.I.) hullrb@vt.edu

SPECIAL FACILITIES

207B Fralin Hall

The Interfaces of Global Change program is an interdisciplinary graduate program that draws faculty and graduate students 6 colleges on campus. The main office is located in 207B Fralin Hall.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

This is not a degree granting program

MATERIAL CULTURE & PUBLIC HUMANITIES

Brian Britt, Chair

Professors: Brian Britt; Humberto Camilloni; Kevin Concannon; Arthur Ekirch; Elizabeth Malbon; Michael Saffle; Bailey Van Hook; Peter Wallenstein;

Associate Professors: Ananda Abeysekara; Marilyn Casto; Matthew Gabriele; William Green; Kathleen Jones; Brian Katen; Ann-Marie Knoblauch; Michelle Moseley Christian; Anita Puckett; Paul Quigley; Emily Satterwhite; Peter Schmitthenner; Rachel Scott; Daniel Thorp;

Assistant Professors: Aaron Ansell; David Cline; Melanie Kiechle; Madhavi Murty; Zhange Ni; LaDale Winling;

Affiliated Faculty: Deborah Sim;

Graduate Contact: ansell78@vt.edu

Graduate Contact: vanhook@vt.edu

Graduate Site: http://www.rc.vt.edu/matcult/

This cross-disciplinary degree with two interrelated emphases (material culture and public humanities) shares common intellectual issues and employment goals. Material culture is the study of material or physical objects, as well as the placement of those objects in critical, theoretical and historical perspectives as the products of distinct cultures. Public humanities bridges the divide between academia and the public by encouraging dialogue between scholars and communities on cultural and social issues. This MA degree prepares graduates to interpret material culture and engage communities with humanities issues within informed historical/ cultural frameworks, so that they are prepared for a wide range of careers in museums, historical societies, and community and cultural organizations. The curriculum entails a minimum of 30-credits of graduate courses. Those students who wish also to complete a thesis will take an additional 6 credits, for a total of 36-credits. 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 GTA or GA; final application deadline is April 15. We will consider students wishing to enroll in the spring semester on a rolling admissions basis when possible. Funding for assistantships, however, is based on the normal (fall-spring) academic year. Applications and all related materials for admission should reach the Graduate School at least eight weeks before the beginning of the semester in which enrollment is requested.

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

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

General: Verbal (60.0), Quantitative (40.0)

Undergraduate B.S. or B.A. degree in a humanities or design discipline, with preference given to students with degrees in Art History, American Studies, History, Political Science, 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. Degree applicants with work or internship experience in a related field will be given special consideration.

BIOLOGICAL TRANSPORT

Professors: Rafael Davalos; Shane Ross; David Schmale; Mark Stremler;

Associate Professors: Daniela Cimini; Raffaella De Vita; Sunghwan Jung; Maria Lazar; Linsey Marr; Stephen Melville; Eva Schmelz; John Socha; Theresa Thompson;

Assistant Professors: Jing Chen; Caroline Jones; Shima Shahab;

Program Administrator: sallys@vt.edu

Biological Transport Program: http://www.biotrans.fralin.vt.edu/

The BITS 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. BITS trainees can receive from 12 to 30 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 the BITS website or contact Sally Shrader, Program Administrator, via email at sallys@vt.edu Colleges, Programs, & Faculty (*Executive Committee members): College of Engineering Biological Systems Engineering – Tess Thompson Civil & Environmental Engineering – Linsey Marr Electrical & Computer Engineering

Engineering Mechanics – Raffaella De Vita, Sunny Jung, *Shane Ross, Shima Shahab, *Jake Socha, Mark Stremler Mechanical Engineering - Bahareh Behkam Biomedical Engineering – Rafael Davalos College of Science Biological Sciences – Jing Chen, *Daniela Cimini, Caroline Jones, Iuliana Lazar, Steve Melville, John Phillips, Zhaomin Yang College of Agricultural & Life Sciences Human Nutrition, Foods, and Exercise – Eva Schmelz 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

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

Biological Transport (BITS) 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.

NUCLEAR ENGINEERING

Azim Eskandarian, Head

Professors: Alireza Haghighat; Jinsuo Zhang;

Assistant Professors: Yang Liu;

Affiliated Faculty: Diana Farkas; Robert Hendricks; Roop Mahajan; Sonja Schmid; Danesh Tafti; James Turso;

Associate Professor of Practice: Mark Pierson;

Graduate Contact: haghighat@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: http://graduateschool.vt.edu/funding/scholarships-and-fellowships.html

Research: http://www.me.vt.edu/graduate-students/graduate-thrust-areas/nes/

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.: http://www.me.vt.edu/nuclear-engineering-program/

Funding opportunities: https://graduateschool.vt.edu/funding.html

Research Groups: http://www.me.vt.edu/nuclear-engineering-program/research-areas-2/

In response to the growing demand from nuclear industry in Virginia, Virginia Tech restarted its nuclear engineering program (NEP) within the Mechanical Engineering Department, and began again to offer undergraduate and graduate nuclear engineering courses. A graduate Nuclear Engineering Certificate is offered along with the PhD, MS & MEng degrees. NEP draws on expertise and courses from the Mechanical and Materials Science and Engineering Departments in Computational Fluid Dynamics in nuclear materials, and expertise from the Physics Department in neutrino physics and accelerated driven system. Affiliate programs include the School Public and International Affairs (SPIA), and the Department Science and Technology Studies in nuclear policy as well as the College of Veterinarian Medicine for its activities in radiation therapy and diagnostics.

SPECIAL FACILITIES

The reintroduction of the Nuclear Engineering degree program has led to facilities available across the Commonwealth of Virginia, including Arlington and Hampton Roads. Interdisciplinary research project crosses several departmental boundaries to provide richer opportunities for graduate students.

Goodwin Hall

The Goodwin Hall houses the Nuclear Engineering offices.

Multi-physics for Advanced Reactor Simulation (MARS) Center

Director: Prof. Alireza Haghighat, Nuclear Engineering Program Objectives: 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, and Physics (Patrick Huber and Bruce Vogelaar). 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) · IInternational Organizations: Paul Scherrer Institut, Switzerland (Jií Kepel, Andreas Pautz, Konstantin Mikityuk); Politecnico di Torino, Italy (Piero Ravetto, Sandra Dulla, Co-PIs)

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 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).

Nuclear Science and Engineering Laboratory - Northern Virginia

Director: Prof. Alireza Haghighat The 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.

Radiation Measurement, Simulation and Visualization Laboratory (RMSVL)

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, medical physics, nuclear safeguards, design of passive and active interrogation systems, benchmarking of particle transport codes and radiation transport visualization. In addition, it provides modeling, simulation and visualization 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 (Southwest Virginia, Virtual, Hampton Roads, Blacksburg, Richmond, 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)

Please contact negrad@vt.edu for specific location information. Acceptance into the VT Nuclear 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 application instructions web page.Master of Science (MS) Degree RequirementsEarning an MS degree requires completing a 30-credit-hour program subject to the following requirements. Except as indicated, courses must be taken for a grade, not Pass/Fail. MS students must submit a Plan of Study before completing the first semester registered as a MS student. No grade below B- is allowed for any core course. 1. Master of Science Courses: A minimum of 21 graded credit-hours of courses must be taken including the following:a. Core Courses (15 graded credit-hours) which include four required courses and one mathematics/statistics course: 12 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) either NSEG 5424 Reactor Thermal Hydraulics or MSE 5384G Advanced Nuclear MaterialsA minimum of 3 graded credit-hours of a mathematics or statistics course from an approved list of courses. b. Elective Courses: Six credit-hours of any science, engineering or mathematics 5000-level, or higher, courses as approved by the 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. 2. Master of Science 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.Ethics: Beginning Fall 2014, all graduate students must meet the Graduate School's Ethics requirement by completing GRAD 5014 Academic Integrity & Plagiarism within the first two semesters. Course work From Another Institution (MS and MEng): 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 will 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 (Southwest Virginia, Virtual, Hampton Roads, Blacksburg, Richmond, 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)

Please contact negrad@vt.edu for specific location information. Acceptance into the VT Nuclear 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 application instructions web page.Master of Engineering (MEng) Degree RequirementsEarning an MEng degree requires completing a 30-credit-hour program subject to the following requirements. Except as indicated, courses must be taken for a grade, not Pass/Fail. MEng students must submit a Plan of Study before completing the first semester registered as a MEng student. No grade below B- is allowed for any core course. 1. Master of Engineering Courses: A minimum of 24 graded credit-hours of courses must be taken including the following:a. Core Courses (15 graded credit-hours) which include four required courses and one mathematics/statistics course: 12 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) either NSEG 5424 Reactor Thermal Hydraulics or MSE 5384G Advanced Nuclear MaterialsA minimum of 3 graded credit-hours of a mathematics or statistics course from an approved list of courses. b. Additional NSEG Course: An additional 3 credit-hours of a graded NSEG 5000-level, or higher, course is required.c. Elective Courses: Six credit-hours of any science, engineering or mathematics 5000-level, or higher, course as approved by the Advisory Committee are required. However, if only three credit-hours of NSEG 5904 are applied toward the degree instead of six credit-hours (see Project 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.Eng. 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. 2. Master of Engineering 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 defend a Project & Report.Seminar Program: All students must participate in the nuclear engineering program seminar series.Ethics: Beginning Fall 2014, all graduate students must meet the Graduate School's Ethics requirement by completing GRAD 5014 Academic Integrity & Plagiarism within the first two semesters. Course work From Another Institution (MS and MEng): 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 would be able to 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 (Southwest Virginia, 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)

Please contact negrad@vt.edu for specific location information. Acceptance into the VT Nuclear 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 application instructions web page. A Ph.D student has a deeper knowledge of the nuclear engineering subject matter than a Master's student and, upon graduation, would be expected to be able to carry out a comprehensive research project. Earning a Ph.D. requires the completion of a 90-credit-hour program (including the courses taken for a Master's degree) subject to the following requirements. Except as indicated, courses must be taken for a grade—not Pass/ Fail. No grade below B- is allowed for any core course. Doctor of Philosophy (PhD) Degree RequirementsThe 90 credit-hours are made up of (1) 30 graded credit-hours of coursework consisting of six core courses and four additional courses in the categories of NSEG 6000-level courses, Breadth or Elective courses, (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. 1. Doctor of Philosophy Courses: A minimum of 30 graded credit-hours of courses must be taken including the following:a. Core Courses (18 graded credit-hours) which include four required courses and two mathematics/statistics courses: 12 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) either NSEG 5424 Reactor Thermal Hydraulics or MSE 5384G Advanced Nuclear MaterialsA minimum of 6 graded credit-hours of a mathematics or statistics courses from an approved list of courses. b. 6000-level NSEG Courses: Any two NSEG 6000-level courses as approved by the Advisory Committee.c. Breadth Requirement: An additional 3 credit-hour NSEG 5000-level, or higher, graded course. This course should provide some breadth by being in an area outside the student's specialization as determined by the student's Advisory Committee.d. Elective Course: Three credit-hours of any science, engineering or mathematics 5000-level, or higher, course as approved by the Advisory Committee is required. 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. 2. Doctor of Philosophy Research Requirement: A minimum of 30 credit hours of NSEG 7994 Research & Dissertation must be completed successfully. 3. 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, would be included under this requirement. Moreover, students who plan to enter academia after completion of their PhD 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 are also encouraged. These electives will also satisfy part of the 30 credit-hours enhancement requirement. 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 or NOVA campus for two consecutive semesters. Seminar Program: All students must participate in the nuclear engineering program seminar series.Ethics: Beginning Fall 2014, all graduate students must meet the Graduate School's Ethics requirement by completing GRAD 5014 Academic Integrity & Plagiarism within the first two semesters. 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 (National Capital Region)

An accelerated graduate program for students from the US Naval Academy (USNA) who are receiving a BS degree in Nuclear Engineering, or Naval Officers to enroll in 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 MS 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.

GRADUATE COURSES (NSEG)

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 (STS 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):

NSEG 5424:

Reactor Thermal Hydraulics

Fundamental processes of hear 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:

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 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

NONE

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 5974:

Independent Study

NONE

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

NONE

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

NONE

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:

Adv Nuclear Reactor Analysis

Neutron transport theory. Neutron slowing down and resonance absorption. Neutron thermalization. Perturbation and variational methods. Homogenization theory. Space-time neutron kinetics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): NSEG 5124 (UG)

Corequisite(s):

NSEG 6334:

Nuclear Reactor Safety

Hazards of nuclea 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

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

Instruction Type(s): Lecture, Online Lecture

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s):

Corequisite(s):

NSEG 7994:

Research and Thesis

NONE

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

Professor: Stephen Eubank; Jennifer Hodgson; Laura Hungerford; Frank Pierson; Kerry Redican;

Associate Professor: Julia Gohlke; Kathryn Hosig;

Assistant Professor: Kaja Abbas; Andrea Bertke; Cassidy Rist;

Associate Professor of Practice: Susan Marmagas; Jacquelyn Pelzer; Valerie Ragan;

Graduate Contact: phs@vt.edu

Graduate Site: http://mph.vetmed.vt.edu/

Virginia Tech's Public Health Program in the Department of Population Health Sciences is administered by the Virginia-Maryland College of Veterinary Medicine in partnership with the Virginia Tech Carilion School of Medicine and is accredited by the Council on Education for Public Health. The professional degree program integrates and expands public health offerings at Virginia Tech and enhances the university's track record of addressing vital public health issues through learning, discovery, and engagement. The program is grounded in an interdisciplinary "One Health" approach. One Health recognizes the dynamic interdependence of human, animal, and environmental health and encompasses the interdisciplinary efforts of medical, veterinary, environmental health, and public health professionals to protect, promote, and improve health. Students gain the requisite knowledge and skills to examine the human, animal, and environmental factors that contribute to the control and prevention of disease and the promotion, enhancement, and maintenance of health.

SPECIAL FACILITIES

DEGREES OFFERED

MPH Degree

Offered In (Blacksburg)

GRE

Verbal: Recommended minimum (150.0)

Quantitative: Recommended minimum (150.0)

The Master of Public Health degree program is a 42-credit professional program grounded in a set of competencies in five core discipline areas (Biostatistics, Environmental Health, Epidemiology, Health Administration, and Health Behavior) as well as a set of professional interdisciplinary cross-cutting competency domains. Students enroll in one of two concentrations: Public Health Education and Infectious Disease. Admissions For information on admissions requirements, please visit our website or contact us at phs@vt.edu or 540-231-3945.

Degree Concentrations:

Public Health Education

Public Health Education Concentration

Infectious Disease

Infectious Disease Concentration

GRADUATE COURSES (PHS)

PHS 5004 (VM 5004):

Fundamentals Public Health

Theory, concepts, and practices related to public health; five major topics of public health including health services, epidemiology, social.behavioral science, public and envrionmental health and biostatistics; special emphasis placed on history of public health, biomedical basis for public health intervention, public health ethics.

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 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; disease vectors and their control; air and water quality; waste management; the built environment, work environments and recreational area; food protection and safety; occuptional health; tools for environmental evaluation, planning and safety. 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 5024:

Epidemiology

Epidemiology is the study of the distribution and determinants of the varying rates of diseases, injuries, or other health states in human and animal populations. This course consists of an introduction to epidemiological terminology, concepts and research methodology.

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 5025:

Epi & Quant Meth Publ Hlth

PHS 5025: Investigation and analysis of dynamics and determinants of disease in communities and populations: philosophy of public health science, ethics, study design, and data analysis. Pre: Graduate Standing. PHS 5026: Investigation and analysis of dynamics and determinants of disease in communities and populations; constructing survey instruments, establishing power and effect sizes; exploration of databases; methods of outbreak investigation; communication of population health 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):

PHS 5026:

Epi & Quant Meth Publ Hlth

PHS 5025: Investigation and analysis of dynamics and determinants of disease in communities adn populations: philosophy of public health science, ethics, study design, and data analysis. Pre: Graduate Standing. PHS 5026: Investigation and analysis of dynamics and determinants of disease in communities and populations; constructing survey instruments, establishing power and effect sizes; exploration of databases; methods of outbreak investigation; communication of population health data.

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 Administration

This course will focus on relevant and timely public health administration concepts. The major topics covered include health policy, health care planning, health care economics, health law, and managerial functions as they relate to health care and public health 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):

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:

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 5244 (HD 5244) (WGS 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHS 5304:

Zoonoses and Infectious Diseases Common to Humans and Animals

Epidemiology of bacterioses, mycoses, chlamydioses, rickettsioses, parasitosis, viroses and prion diseases that are transmissible between animals and humans and/or are aquired by animals and human from the same source and that have great impact on public health. Cultural, social and economic factors and impacts; modes of inter - and intra- species transmission including roles of vectors and environmental factors; concepts of emergence and re-emergence; pathogenesis in various hosts and host adaptation; temporal and spatial dynamics and risk factors for exposure, infection and expression of clinical disease; modes of detection, control/mitigation and prevention; biosecurity, including food safety and security. 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 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 ecnomic contributors to infectious disease propagation; detection and surveillance; geographic information systems; epidemiologic study design; and infectious disease modeling. 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 5324:

Pub Hlth Infect Contrl & Prev

Assessment, policies, and procedures for control and prevention of infectious diseases in communities and populations. Sources, tranmission mode, and local community to international dissemination of infectious disease agents; antimicrobial and chemical resistance; vaccein development, safety, and coverage; community and hospital based needs and interventions; and regulatory frameworks. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHS 5334:

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 5354:

Modeling Infectious Diseases

Mathematical modeling of infectious diseases in humans and animals. Deterministic susceptibles-infectious-recovered (SIR) and related models, estimation of reproductive number, host heterogeneities, multi-pathogen/multi-host models, spatio-temporal models, stochastic dynamics, and modeling for public health 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):

PHS 5504:

Epidemiolgy and Biostatistics in Public Health for Veterinarians

Statistical assessment of dynamics and determinants of disease in commmunites and populations; study design and statistical analyses; exploration of databases; problem based for students to integrate veterinary and public health domanins. Pre: Graduate standing.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHS 5644 (HD 5644):

Program Evaluation

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

Instruction Type(s): 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 5834:

Public Health Seminar

Current topics in public health research, policy and practice, including biostatistics, epidemiology, health policy, environmental health, social and behavioral medicine, infectious diseases, and public health education. Pre: Graduate Standing. P/F only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHS 5904:

Project and Report

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

Instruction Type(s): 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

Instruction Type(s): 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 student's 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

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHS 5934:

MPH Professional Preparation

Professional preparation for public health practice and the required field practicum for the Master of Public Health (MPH) degree. Setting of professional goals; exploration of practicum placement opportunities and shadowing experiences; intial selection/preparation of practicum learning contract; skill building in resume writing, interviewing, communications, technical writing, professionalism, leadership. Pre: Graduate standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

Instruction Type(s): Lecture

Prerequisite(s):

Corequisite(s):

PHS 5974:

Independent Study

NONE

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):

PHS 5984:

Special Study

NONE

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

NONE

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: Rafael Davalos; Kent Nakamoto; Anju Seth;

Associate Professors: Jennifer Barrett; Christopher Byron; Linda Dahlgren; Aaron Goldstein; William Huckle; Mark Van Dyke; Vincent Wang; Abby Whittington;

Assistant Professors: Jia-Qiang He; Ashley Heflin; Blake Johnson; Michelle Theus;

Adjunct Professors: Willard Eyestone;

College of Veterinary Medicine: Jennifer Barrett; Christopher Byron; Linda Dahlgren; Willard Eyestone; Jia-Qiang He; William Huckle; Michelle Theus;

College of Engineering: Rafael Davalos; Aaron Goldstein; Blake Johnson; Mark Van Dyke; Vincent Wang; Abby Whittington;

College of Liberal Arts & Human Sciences: Ashley Heflin;

Pamplin College of Business: Kent Nakamoto; Anju Seth;

Abby Whittington: awhit@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 Abby Whittington (awhit@vt.edu) or Linda Dahlgren (lad11@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 (Blacksburg, Leesburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

Regenerative Medicine is not a degree-granting program.

REMOTE SENSING

Professors: Thomas Burbey; James Campbell; William Hession; Richard Hirsh; Eric Patterson; Wayne Scales; Layne Watson; Randolph Wynne;

Associate Professors: Amos Abbott; Joseph Baker; Saul Halfon; Kevin Kochersberger; Klaus Moeltner; John Ruohoniemi; Valerie Thomas;

Assistant Professors: Xinwei Deng; Yang Shao; Robert Thomas;

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

Randolph Wynne: wynne@vt.edu

Wayne Scales: wscales@vt.edu

Valerie Thomas: thomasv@vt.edu

Joseph Baker: jo.baker@vt.edu

Graduate Site: http://rsigep.frec.vt.edu/index.htm

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 engineering, theory, data analysis, applications, and policy.Our 17 faculty members span 5 colleges and 12 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) Statistics (STAT)

SPECIAL FACILITIES

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

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 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 VERY important 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 department and the Remote Sensing Certificate, plus take GRAD 5134 (Interdisciplinary Research in Remote Sensing) at least once and the Interdisciplinary Seminar in Remote Sensing (FOR/GEOG 5104 or equivalent), if offered, each semester in which they are enrolled on campus.

SUSTAINABLE NANOTECHNOLOGY

Professors: Michael Hochella; Linsey Marr; Amy Pruden-Bagchi; Peter Vikesland;

Associate Professors: Earl Foster; Maren Roman;

Assistant Professors: Guoliang Liu; Frederick Michel;

Research Faculty: Weinan Leng;

University Distinguished Professor: Michael Hochella;

W. Thomas Rice Professor: Amy Pruden-Bagchi;

Research Associate Professors: Sean McGinnis;

Research Assistant Professors: Matthew Hull;

Peter Vikesland: pvikes@vt.edu

Matthew Chan: mychan@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.

TRANSLATIONAL OBESITY RESEARCH

Professors: Isabel Bradburn; George Davis; Brenda Davy; Kevin Davy; Dongmin Liu; Richard Winett;

Associate Professors: David Brown; Deborah Good; Matthew Hulver; Donald McCrickard; Andrew Neilson; Monica Ponder; Jyoti Savla; Eva Schmelz; Wen You;

Assistant Professors: Zhiyong Cheng; Samantha Harden; Valisa Hedrick; Vivica Kraak; Carlin Rafie; Bin Xu;

Research Assistant Professors: Madlyn Frisard;

General Contact: lucindas@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 EconomicsCollege of Liberal Arts and Human Sciences Human Development CommunicationsCollege of Science PsychologyFor more information please contact: Kevin Davy, kdayy@vt.edu or Paul Estabrooks, estabrkp@vt.edu, Co-Principal Investigators

SPECIAL FACILITIES

This is an interdisciplinary program and shares facilities among departments across campus.

Facilities

This is an interdisciplinary program and shares facilities among departments across campus.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

TRANSLATIONAL PLANT SCIENCE

Professors: Eric Beers; Glenda Gillaspy; Elizabeth Grabau; John McDowell; Mohammad Saghai-Maroof; David Schmale; Ann Stevens; Richard Veilleux; Boris Vinatzer; James Westwood; Brenda Winkel;

Associate Professors: Amy Brunner; Eva Colla'kova'; John Jelesko; Guillaume Pilot; Birgit Scharf; Dorothea Tholl; Bingyu Zhao;

Assistant Professors: Aureliano Bombarely Gomez; Takeshi Fukao; David Haak; Jason Holliday; Song Li; Xiaofeng Wang; Susan Whitehead;

John M. McDowell: johnmcd@vt.edu

TPS Web Page: translationalplantscience.org

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 program (translationalplantscience.org) spans seven 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 ability to engage the public in meaningful dialog 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 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 Agricultural and Applied Economics Biochemistry Biological Systems Engineering Crop, Soil, and Environmental Science Horticulture Plant Pathology, Physiology, and Weed Science College of Science Biology College of Natural Resources and Environmental Sciences Forestry For more information please contact John McDowell, Principal Investigator, johnmcd@vt.edu

SPECIAL FACILITIES

A group of more than twenty 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. We are primarily housed in Latham Hall. 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, professor of plant pathology, physiology, and weed science, 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: (550.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

Minimum GPA from bachelor degree: 3.0 GRE General Test required: Verbal, Quantitative, Analytical Writing/Analytical**No GRE Subject Test requiredTOEFL: Paper-based 550, Computer-based 213, IBT 80, IELTS Band 7

WATER INTERFACE: INTERDISCIPLINARY RESEARCH TRANSCENDING BOUNDARIES OF ENGINEERING, SCIENCE, AND HUMAN HEALTH

Professors: Brenda Davy; Kevin Davy; Andrea Dietrich; Susan Duncan; Joseph Falkinham; Sean O'Keefe; Amy Pruden-Bagchi; Stephen Schoenholtz;

Associate Professors: Daniel Gallagher; Jason He; Elena Serrano;

Assistant Professors: Curtis Friedel; Valisa Hedrick; David Kuhn;

Aili Wang: waili9@vt.edu

Graduate Site: https://www.facebook.com/waterVT?ref=aymt_homepage_panel

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? Scientists (physical, biological, health and social) and engineers to evaluate and implement cost-effective sustainable solutions to global water challenges with integration of 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. The "interfacial tensions" related to technological feasibility versus societal fears of water treatment options and regulatory standards versus public acceptance of water quality can be overcome with a new Water INTERface approach. 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: Ethics in Engineering, Science and Public Policy (CEE 5804) (3 credits) Water for Health Seminar (GRAD 5414) (1 credit) Interdisciplinary Research (GRAD 5134) (3 credits) Independent Research Study (GRAD 5974) (2 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. 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. Facilities, Equipment, and Other Resources in Food Science & TechnologyFacilities, 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.

DEGREES OFFERED

IGEP Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

------ A 9 credit Graduate Certificate in Interdisciplinary Water and Health Science: • Ethics in Engineering, Science and Public Policy (CEE 5804) (3 credits) • Water for Health Seminar (GRAD 5414) (1 credit) • Interdisciplinary Research (GRAD 5134) (3 credits) • Independent Research Study (GRAD 5974) (2 credits) · Involvement with Water INTERface IGEP community and activities. · Participation in blogging and research presentations. Each Water INTERface graduate student must meet the requirements of their home academic department in addition to the overall Water INTERface requirements.

ASPECT
ASPC

Address:
___ 220 Stanger Street, 202 Major Williams Hall (0192)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• ASPECT

Web Resource(s):
• Website

Phone Number(s):
• *ASPECT:*
540/231-0698

Certificate Overview | Admissions & Course Requirements

Certificate Overview

Applications for the Graduate Certificate in Social, Political, Ethical and Cultural Thought will be considered from non-degree post-baccalaureate students who have been permitted to take courses by the Graduate School, and Master's, professional and/or Ph.D. graduate students accepted in ASPECT or other programs at Virginia Tech who seek to enhance their training in interdisciplinary thought, methodology, and theory.

How to Apply:
Fill out the online application for participation in the certificate program.

ASPECT
ASPC

Address:
___ 220 Stanger Street, 202 Major Williams Hall (0192)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• ASPECT

Web Resource(s):
• Website

Phone Number(s):
• *ASPECT:*
540/231-0698

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Students new to Virginia Tech will be considered on the basis of transcripts, a statement of purpose, two letters of recommendation and other requirements specified by the Graduate School. Students previously admitted by the Graduate School or accepted as graduate students in a cognate program will submit to the director a statement of purpose and at least one letter of recommendation.

Course Requirements

15 credit hours.
Please consult http://liberalarts.vt.edu/departments-and-schools/alliance-for-social-political-ethical-and-cultural-thought/academic-programs/aspect-graduate-certificate.html for details

Africana Studies
AFSC

Address:
562 McBryde Hall (0137) Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Onwubiko Agozino

Web Resource(s):
• Website

Phone Number(s):

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:
562 McBryde Hall (0137) Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Onwubiko Agozino

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

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

Air Transportation Systems
ATRC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Air Transportation Systems - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Air Transportation Systems ATRC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Blacksburg: Lindy Cranwell

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-7296

Certificate Overview | Admissions & Course Requirements

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School "certificate seeking" application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called "Application for Degree or Certificate Conferral" through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called "Application for Certificate" and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called "Application for Degree or Certificate Conferral" through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the

changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

2. CEE students and non-degree-seeking students must complete the Application for Degree or Certificate Conferral form online in Hokie SPA by the deadline for the semester you will complete your certificate program. You will find the ADCC form under the Graduate Student Degree Menu/Application for Degree section of Hokie SPA.

3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called “Graduate Certificate Application” to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

Main Blacksburg Campus contacts :

Graduate Student Coordinator

Lisa K. Burns, lkburns@vt.edu, (540)-231-6069

Director of International & Graduate Education:

Lindy Cranwell, lindycra@vt.edu, (540) 231-7296

CEE Graduate Director:

Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:

Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Advanced Transportation Systems

Air Transportation Systems

All students must complete CEE 5614: Analysis of Air Transportation Systems.

The remaining three courses must be selected from those listed below:

- CEE 5660: Transportation Risk, Reliability and Security
- CEE 5600: Civil Infrastructure Systems Analysis
- CEE 5620: Transportation Network Analysis
- ENGR 5014: Applied Systems Engineering
- ISE 5484: Modeling Processes in Operations Research
- An Approved Technical Elective Course

Air Transportation Systems ATRC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Air Transportation Systems - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Air Transportation Systems ATRC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall,
MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School “certificate seeking” application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called “Application for Certificate” and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

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changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

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3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called “Graduate Certificate Application” to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

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CEE Graduate Director:

Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:

Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Advanced Transportation Systems

Air Transportation Systems

All students must complete CEE 5614: Analysis of Air Transportation Systems.

The remaining three courses must be selected from those listed below:

- CEE 5660: Transportation Risk, Reliability and Security
- CEE 5600: Civil Infrastructure Systems Analysis
- CEE 5620: Transportation Network Analysis
- ENGR 5014: Applied Systems Engineering
- ISE 5484: Modeling Processes in Operations Research
- An Approved Technical Elective Course

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

Business Analytics and Data Mining
BADC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Assistance:* 703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Business Analytics and Data Mining

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 certificate in Business Information Systems 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.

How to Apply:
Fill out the online application for participation in the certificate program.

Business Analytics and Data Mining BADC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Assistance:* 703/538-8384

Certificate Overview | Admissions & Course Requirements

Admissions Requirements

Prospective students wishing to complete a graduate certificate in the MIT program will apply online and submit an official transcript showing a bachelor's degree conferral from a regionally accredited university with a minimum GPA of 3.0, and a current resume.

Course Requirements

To earn the certificate in Business Analytics and Data Mining, students must complete the following courses:

- BIT 5524-Introduction to Business Intelligence & Analytics
- BIT 5534-Advanced Business Intelligence & Analytics
- ACIS 5504-Information Systems Design & Database Concepts
- ACIS 5524- Advanced Database Management

Civil Infrastructure Systems IEC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Civil Infrastructure Systems - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Civil Infrastructure Systems IEC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School “certificate seeking” application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called “Application for Certificate” and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the

changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

2. CEE students and non-degree-seeking students must complete the Application for Degree or Certificate Conferral form online in Hokie SPA by the deadline for the semester you will complete your certificate program. You will find the ADCC form under the Graduate Student Degree Menu/Application for Degree section of Hokie SPA.

3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called “Graduate Certificate Application” to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

Main Blacksburg Campus contacts :

Graduate Student Coordinator
Lisa K. Burns, lkburns@vt.edu, (540)-231-6069

Director of International & Graduate Education:
Lindy Cranwell, lindycra@vt.edu, (540) 231-7296

CEE Graduate Director:
Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:
Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Civil Infrastructure Systems

Civil Infrastructure Systems

All students must complete either CEE 5600: Civil Infrastructure Systems Analysis or CEE 5754: Pavement and Bridge Management Information Systems.

The remaining three courses must be selected from those listed below or from the course not selected from the list above:

- CEE 5010: Schedule Impact Analysis
- CEE 5084: Information Technology in Construction
- CEE 5614: Analysis of Air Transportation Systems
- CEE 5634: Analysis and Planning of Mass Transit Systems
- CEE 5080: Infrastructure Asset Management
- CEE 5014: Facility Delivery and Finance Strategies
- An Approved Technical Elective Course

Cognition and Education CEC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

How to Apply:
Fill out the online application for participation in the certificate program.

Cognition and Education CEC

Address:
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Course Requirements

Collaborative Community Leadership
CCLC

Address:
214 Litton-Reaves Hall, Mail Code: 0343
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Eric Kaufman

Web Resource(s):
• Website

Phone Number(s):
• *Eric Kaufman:* 540/231-6258

Certificate Overview | Admissions & Course Requirements

Why this certificate?

Surveys conducted by Harvard University indicate that Americans believe “we have a leadership crisis in the country today.” Furthermore, the sentiment is that “unless we get better leaders, the United States will decline as a nation” (Rosenthal, 2012). In our rapidly changing world, we need leaders with interdisciplinary skills to solve complex societal issues on local, national, and international levels (Getha-Taylor, 2008). 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.

Collaborative Community Leadership
CCLC

Address:
214 Litton-Reaves Hall, Mail Code: 0343
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Eric Kaufman

Web Resource(s):
• Website

Phone Number(s):
• *Eric Kaufman:* 540/231-6258

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). Click here for a list of core courses and electives.

Computational Engineering Science & Mechanics
ESMC

Address:
Department of Biomedical Engineering Mechanics (MC0298)
325 Kelly Hall, 325 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Engineering Mechanics Graduate Program

Web Resource(s):

Phone Number(s):
• *Amanda Covey:* 540/231-8789

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This certificate is no longer being offered.

How to Apply:
Fill out the online application for participation in the certificate program.

Computational Engineering Science & Mechanics ESMC

Address:
Department of Biomedical Engineering Mechanics (MC0298)
325 Kelly Hall, 325 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Engineering Mechanics Graduate Program

Web Resource(s):

Phone Number(s):
• *Amanda Covey:* 540/231-8789

Certificate Overview | Admissions & Course Requirements

Admission Requirements

This certificate is no longer being offered.

Course Requirements

This certificate is no longer being offered.

Data Analytics
DAC

Address:
3160D Torgersen Hall, Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wanawsha Hawrami, 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

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, at most 6 of the required 12 credits for the certificate can be double counted towards their degree program, meaning that 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.

Data Analytics
DAC

Address:
3160D Torgersen Hall, Virginia Tech
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Wanawsha Hawrami, 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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/certificate_application.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 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 5606 Signal Detection and Estimation

ECE 5734 Convex Optimization

ECE 6504 Deep Learning for Perception

ECE 6554 Advanced Computer Vision

CS6424/ECE6424 Probabilistic Graphical Models and Structured Prediction

Graduate Certificate in Data Analytics

http://dac.cs.vt.edu/academics/data-analytics/

Database Management
DMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Assistance:*
703/538-8384

Graduate Certificate in Database Management

The certificate in Database Management covers business information systems development, database design and management, and the design and implementation of interactive computer-based information systems that use decision rules, models, and comprehensive databases to support the decision making process. Students will be prepared to become a business information systems developer using both structured and object-oriented systems development approaches, and to be able to design and develop business information systems that use a relational database. The certificate also includes an in-depth coverage of methods for data access, modeling and computation using a visual language, graphical display of support material and report generation methodologies, object sharing between software components, and the deployment of support systems within a distributed computing environment. Client server systems, common object model methodologies, and the distribution of support systems in a web based environment are examined in the context of distributed decision support systems.

How to Apply:
Fill out the online application for participation in the certificate program.

Database Management
DMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Assistance:* 703/538-8384

Certificate Overview | Admissions & Course Requirements

Admissions Requirements

Prospective students wishing to complete a graduate certificate in the MIT program will apply online and submit an official transcript showing a bachelor's degree conferral from a regionally accredited university with a minimum GPA of 3.0, and a current resume.

Course Requirements

To earn the certificate in Database Management, students must complete the following courses:

- ACIS 5504-Information Systems Design & Database Concepts
- ACIS 5524-Advanced Database Management
- BIT 5474-Computer-Based Decision Support Systems
- BIT 5484-Cognitive Computing for Smart Service Systems

Economic Development
ECDC

Address:
1021 Prince Street, Suite 200
Alexandria, VA 22314

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.

Economic Development
ECDC

Address:
1021 Prince Street, Suite 200
Alexandria, VA 22314

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:

http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

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.

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.

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):

Admission Requirements

Course Requirements

Educational Research
ERC

Address:
Educational Research and Evaluation, 1750 Kraft Drive, Corporate Research Center
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Gary Skaggs, EDRE Program Leaderh
• Wanda McAlexander

Web Resource(s):
• EDRE Webpage (Section on Certificate)

Phone Number(s):
• *Wanda McAlexander:* 540/231-5106

Certificate Overview | Admissions & Course Requirements

Overview of the Certificate

The EDRE Graduate Certificate in Educational Research is designed to recognize graduate students who have completed specialized EDRE courses in statistics, measurement, qualitative research, assessment, and/or mixed methods research. The Certificate is designed to recognize graduates who have become proficient in a variety of educational research strategies that go beyond what is learned in foundational or introductory courses. The Certificate is also designed for those who have already earned a graduate degree, but aspire to gain a credential in educational research that will be useful in the workplace.

Learning Outcomes

This certificate conveys that a graduate student has developed a mastery of educational research that is beyond the foundational level. Anticipated learning outcomes include the ability to:

- Master multiple strategies to conduct educational research, including those requiring proficiency in qualitative, quantitative, and/or mixed methods research methodologies.
- Evaluate the quality and research proposals, publications, and reports.
- Develop a proposal for a credible research or assessment study.
- Identify research procedures that are suitable to the context and purpose of the proposed study.
- Interpret data, describe results, and extrapolate the appropriate application of results to other settings.
- Develop the written and oral skills necessary to present information about research and assessment projects.

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. Gary Skaggs, EDRE Program Leaderh
• Wanda McAlexander

Web Resource(s):
• EDRE Webpage (Section on Certificate)

Phone Number(s):
• *Wanda McAlexander:* 540/231-5106

Admission Requirements

Upon completion of the certificate requirements, students must apply for conferral of the Certificate using the Application for Degree and Certificate Conferral form available on the Graduate School web site. Students earning both a degree and the certificate submit two Application for Degree and Certificate Conferral forms.

A separate EDRE application for the certificate is no longer required.

Curriculum Requirements

Number of Credit Hours: The EDRE Graduate Certificate requires 9 hours of specialized courses from EDRE. This **excludes** foundational or introductory courses that are prerequisites for specialized courses (i.e. Quantitative Research I and 2 (EDRE 6605-6606): Qualitative Research I (EDRE 6504), and all 5000 level EDRE courses). All courses must be completed with a grade of B or better. Courses completed with a pass/fail or audit option do not count toward the Certificate. Transfer credit or credit from courses completed in programs other than EDRE are not accepted.

EDRE 6634: Advanced Statistics is required for all upper-level quantitative courses. It counts toward the Certificate. Prerequisites for each course are noted in the section providing a description of all the courses that count toward the Certificate.

Recommended Combinations of EDRE Specialized Courses

Measurement: 6634, 6624, 6654, 6684 (Ethical Practices)

Statistics: 6634, 6654, 6664, 6694, or relevant Advanced Issues Course

Assessment: 6524, 6704, 6744, 6744 (5984 in Assessment), 6684 (Ethical Practices)

Qualitative/Mixed Methods: 6524, 6744, 6684 (Advanced issues in QUAL), 6684 (Ethical Practices in Educational Research)

Courses Counting toward the Certificate and Their Pre-Requisites

EDRE Courses that Count Toward the Certificate

6524

Qualitative Methods in Educational Research II (3H, 3C) (Pre: EDRE 6504)
This course provides an advanced examination of qualitative inquiry in educational and human science research. It considers theoretical assumptions of major qualitative research traditions and provides students advanced skills in data analysis and representation. Offered fall and spring each year.

6534

Ethnographic Research Methods in Education (3H, 3C) (Pre: EDCI 6034)

Exploration of ethnographic methods for data collection and analysis: theoretical bases, procedures, issues, and applications of this approach in educational research. (Cross-listed with EDCI 6534)

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.

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.

6654

Multivariate Statistics for Applications to Ed 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.

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.

6684

Instrument Development and Validation (3H, 3C) (Pre: EDRE 6634)
Provides experiences in developing instruments, or tests, that are designed to measure educational and psychological constructs, such as knowledge, skills, attitudes, and traits. Issues and practices relating to construct specification, instrument design and administration, and analysis and summary of validity study data will be emphasize. Offered fall, yearly.

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 technique 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.

6704

Evaluation Methods in Education (3H, 3C) (Pre: EDRE 5404)
Principles of evaluation with emphasis on practices applicable to a variety of educational settings. The theoretical and philosophical bases which lead to alternative methodologies. Design and measurement alternatives are considered within the jurisdictional, theoretical, and philosophical contexts. Offered fall and spring each year.

6744

Mixed Method Research Design (3H, 3C) (Pre: EDRE 6606 and EDRE 6504)
Provides an introduction to mixed methods research design in the human and behavioral sciences. Students will design and execute a pilot study for a mixed method research project. Offered fall each year.

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.

6774

Advanced Issues in Psychometric Research (3H, 3C) (Pre: EDRE 6624 or 6684)
Provides an in-depth look at 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.

6784

Advanced Issues in Qualitative Research (3H, 3C) (Pre: EDRE 6524)
Provides advanced treatment of important theoretical and methodological topics in the contemporary qualitative literature and in the ongoing development of qualitative methodology. Emphasis is placed on addressing both theoretical issues and issues of research praxis. Topics covered vary from term to term. Offered irregularly, spring.

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. Longitudinal Data Analysis has been offered each spring for a number of years.

Certificate Application Form

EDRE Grad Certificate Application Form

Fall 2016 and After - Additional Application Materials

We are now expected to have measures to demonstrate student outcomes for those who complete the EDRE graduate certificate in educational research. You can satisfy this requirement in any of the following ways:

1. Attach a copy of an *individually authored* research paper, proposal, poster presentation, or Power Point presentation that you have completed within the last two years. This can also be the methods chapter from your dissertation or an individually authored paper from an EDRE course.
2. An individually authored proposal for an assessment or evaluation of a program.

An EDRE faculty member with relevant expertise will rate your submission using the a Certificate Evaluation Rubric. No minimum score is required.

The faculty member will score your submission using the following criteria:

1. Clarity of the statement of the need and contribution.
2. Insightfulness of the discussion about the conclusions.
3. Relevance of the literature summarized.
4. Methodological expertise demonstrated by the description of the methods and procedures.

Additional Application Requirements for Fall 2016 and After

Effective in 2016, we are required to assess the skills and knowledge gained by students completed the Certificate. This adds a step to the application process through the program. These are options for meeting the new requirement:

1. Attach a document to the paper application that is a research proposal or presentation you authored in the last two year. It can be a poster or Power Point presentation you made at a conference. It could also be a research-related prelim answer you wrote or the methods chapter from your dissertation.
2. Attach a document to the paper application that is a proposal for the evaluation or assessment of a program.

Your submission will be evaluated by an EDRE faculty member with relevant expertise using a rubric with the following items. No minimal score is required.

1. Fit between the purpose and research questions and the research methods.
2. Insightfulness of the discussion.
3. Clarity of the statements identifying the need and contribution.

Emerging Devices Technologies
EDTC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview

How to Apply:
Fill out the online application for participation in the certificate program.

Emerging Devices Technologies
EDTC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• Website

Phone Number(s):

Admission Requirements

Course Requirements

Engineering Education
ENGC

Address:
Department of Engineering Education (0218)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• David Knight
• Linda Hazelwood

Web Resource(s):
• Website

Phone Number(s):
• *Department Receptionist:* 540/231-6555
• *Department Graduate Coordinator:* 540/231-7359

Certificate Overview

Our Graduate Certificate in Engineering Education is popular with students from across the College of Engineering. Requiring 13 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):
• David Knight
• Linda Hazelwood

Web Resource(s):
• Website

Phone Number(s):
• *Department Receptionist:* 540/231-6555
• *Department Graduate Coordinator:* 540/231-7359

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. The Committee will stipulate coursework that the student would need to begin studies for the Certificate and may recommend that the student be admitted on a provisional basis until the specified coursework is successfully completed. In general, the specified coursework will not count toward the credits required for the Certificate.

Please visit enge.vt.edu to download the application.

Course Requirements

Required core courses (7 credits):

- **ENGE 5014:** Foundations of Engineering Education (3 cr) Sample Syllabus
- **ENGE 5504:** Practicum in the Engineering Classroom (1 cr) Sample Syllabus
- **GRAD 5104:** Preparing the Future Professoriate (3 cr)

A minimum of three (3) credits from the Pedagogy List

- **GRAD 5114:** Pedagogical Practices in Contemporary Contexts (3 cr)
- **ENGE 5024:** Design in Engineering Education and Practice (3 cr)
- **ENGE 5204:** Design of Laboratory Courses for Engineering Education (3 cr)
- **ENGE 5404:** Assessment Techniques in Engineering Education (3 cr) Sample Syllabus

A maximum of three (3) credits from the Elective List

- Recommended electives related to teaching
-
    - **EDCI 5114:** Advanced Educational Psychology (3 cr)
    - **EDCI 5164:** Principles of Instructional Design (3 cr)
    - **EDCI 5604:** Distance Education (3 cr)
    - **EDCI 6644:** College Teaching (3 cr)
    - **GRAD 5004:** GTA Workshop (1 cr)
    - **GRAD 5984:** Critically Engaged Teaching with Advanced Technology (3 cr)
    - **STS 6614:** Advanced Topics in Technology Studies (Engineering only) (3 cr)
    - **ELPS 6424:** Institutional Effectiveness & Outcome Assessment in Higher Education (3 cr)

- Other electives (more research-focused) that we will also accept toward the certificate :
-
    - **ENGE 5604:** Engineering Education Research Methods (3 cr) Sample Syllabus
    - **EDRE 5404:** Foundations of Educational Research & Evaluation (3 cr)
    - **EDRE 6605-6606:** Quantitative Research Methods in Education I & II (3 cr each)
    - **EDRE 6614:** Qualitative Methods in Educational Research (3 cr)

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):

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, students 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.

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):

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)*

Environmental Politics & Policy
PEPC

Address:
Political Science (0130) Major Williams Hall Room 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Director of Graduate Studies

Web Resource(s):
• Virginia Tech Online

Phone Number(s):
• *Telephone:* 540/231-6572

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This graduate certificate in Environmental Politics and Policy targets non-degree-seeking students and students in the Virginia Tech MA program in Political Science who wish to demonstrate special competence in environmental politics and policy. This certificate program responds to an existing demand by degree-seeking and non-degree students, studying on campus or through on-line courses. It will recognize coursework that students have taken that focuses on developing a foundation in environmental politics and policy.

How to Apply:
Fill out the online application for participation in the certificate program.

Environmental Politics & Policy
PEPC

Address:
Political Science (0130) Major Williams Hall Room 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Director of Graduate Studies

Web Resource(s):
• Virginia Tech Online

Phone Number(s):
• *Telephone:* 540/231-6572

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

Foundations of Political Analysis
PPAC

Address:
Political Science (0130) Major Williams Hall Room 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Director of Graduate Studies

Web Resource(s):
• Website

Phone Number(s):
• *Telephone:* 540/231-6572

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This graduate certificate program targets non-degree-seeking students and students in the Virginia Tech MA program in Political Science who wish to demonstrate special competence in the Foundations of Political Analysis. This certificate responds to an existing demand by degree-seeking and non-degree students, studying on campus or on-line. It will recognize the coursework that students successfully complete as they focus on developing a foundation in political analysis.

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 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• General Contact
• Director of Graduate Studies

Web Resource(s):
• Website

Phone Number(s):
• *Telephone:* 540/231-6572

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

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

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.

Geospatial Information Technology
GITC

Address:
Department of Geography, 105 Major Williams Hall, 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Laurence (Bill) Carstensen

Web Resource(s):

Phone Number(s):
• *Bill Carstensen:* 540/231-2600

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 backgr
goals.

How to Apply:
Fill out the online application for participation in the certificate program.

Upon processing of the application, you will be contacted with information about the submission of additional required materials. Thank you for your interest.

Geospatial Information Technology
GITC

Address:
Department of Geography, 105 Major Williams Hall, 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Laurence (Bill) Carstensen

Web Resource(s):

Phone Number(s):
• *Bill Carstensen:* 540/231-2600

Certificate Overview | Admissions & Course Requirements

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. Bill Carstensen 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 bring the certificate application form to Dr. Bill Carstensen 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. Bill Carstensen, chair of the Oversight Committee, for a signature, and then take Application for Certificate Conferral Form to the Graduate School.

Course Requirements

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.

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 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.
- 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 5264 - GIS Applications in Natural Resource Management
  Acquiring and using publicly available natural resources data sources. Methods and algorithms for terrain modeling and landscape metrics. Evaluation of the impacts of data errors and variability on analysis results, including sensitivity analysis of GIS-based resource assessments. Special issues related to temporal data and the management of natural resources information systems.
- 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, diditization, 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 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 5134G - Advanced Water, Hazards, and Development
  Geographical analysis of water as a hazard upon human (infrastructure, economy) and natural (rivers, groundwater) systems in the form of hydrometeorological events, water- and vector-borne disease, climate change, dams, and eutrophication. Development of proficiency in demonstrating the multidimensionality of water resources. Pre: Graduate Standing.
- 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.
- 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 Advisors and Departments

List of Potential Advisors and Departments

- Conrad Heatwole <heatwole@vt.edu> BSE
- Cully Hession <chession@vt.edu> BSE
- Randy Dymond <dymond@vt.edu> CEE
- Kitty Hancock <hancockk@vt.edu> CEE
- John Galbraith <ttcf@vt.edu> CSES
- Val Thomas <thomasv@vt.edu> FREC
- Randolph Wynne <wynne@vt.edu> FREC
- Bill Carstensen <carstens@vt.edu> GEOG
- Jim Campbell <jayhawk@vt.edu> GEOG
- Peter Sforza <sforza@vt.edu> GEOG
- Yang Shao yshao@vt.edu GEOG
- Mintai Kim <mintkim@vt.edu> LA
- Patrick Miller <pmiller@vt.edu> LA
- Kris Wernstedt <krisw@vt.edu> UAP NoVA

- Yang Zhang <yz@vt.edu> UAP

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 Associate 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 associate 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 associate 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.

Global Planning and International Development Studies GPIC

Address:
Blackburg, VA 24061

Contact this Certificate

Email Contact(s):
• John Browder

Web Resource(s):
• Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

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, 30-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.

Global Planning and International Development Studies GPIC

Address:
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• John Browder

Web Resource(s):
• Website

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)
2. UAP 5764 International Development Planning Studio (3H)

Note: UAP/AAE 6314 Applied Development Economics (or equivalent) may be required of students not having adequate development economics background (to be determined by certificate coordinator in consultation with student's department faculty advisor).

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.]

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

The 9-credit Graduate Certificate in Global Sustainability (GCGS) is designed for students and professionals seeking training and experience in international sustainable development, with a particular emphasis on environmental sustainability in emerging economies. The GCGS consists of 2 electives and 1 required course, NR 5114 Global Issues in Natural Resources, that includes a 10-day International Field Experience (IFE). The GCGS is a good option for graduate students and professionals looking to gain formal international experience while earning graduate credits.

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

GCGS Admission Requirements

Students can apply for the Graduate Certificate in Global Sustainability as a (VT) degree-seeking student, non-degree seeking 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

Course Requirements

The GCGS can be completed in a single academic term or over the course of several. A defining element of the certificate program is participating in an International Field Experience (IFE) through NR 5114 Global Issues in Natural Resources. All NR courses are offered online for three credits unless otherwise noted.

Required coursework:

- NR 5114 Global Issue in NR (with IFE) - 3 hours
- NR Elective - 3 hours
- NR Elective - 3 hours

As part of our mission to build leadership for global sustainability, IFEs explore challenges to sustainable development and the innovative cross-boundary strategies being developed to address these challenges. IFEs entail 10 days of face-to-face fieldwork in the region of focus, with the remainder of the project work conducted virtually, providing students the opportunity to travel and gain valuable real-world international and cross-cultural experience. Upcoming IFEs are scheduled for:

- Morocco (Fall 2017)
- India (Spring 2018)
- Croatia (Summer 2018)
- China (Fall 2018)
- South Africa (Spring 2019)
- Bali, Indonesia (Summer 2019)

Health Information Technology
HITC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Suite 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Information:*
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 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Information:*
703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate Admissions

Prospective students wishing to complete a graduate certificate in the MIT program will apply online and submit an official transcript showing a bachelor's degree conferral from a regionally accredited university with a minimum GPA of 3.0, and a current resume.

Course Requirements

To earn the certificate in Health Information Technology, students must complete the following courses:

- BIT 5564 – Healthcare Information
- ACIS 5574 – Healthcare Data Management
- BIT 5524 – Introduction to Business Intelligence & Analytics
- BIT 5534 – Advanced Business Intelligence & Analytics

Higher Education Administration
HEAC

Address:
1750 Kraft Dr. Suite 2000
Blacksburg, VA 24060

Contact this Certificate

Email Contact(s):
• Gabriel Serna

Web Resource(s):
• Website

Phone Number(s):
• *Office Phone::*
540/231-5872

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 tenure track 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. Suite 2000
Blacksburg, VA 24060

Contact this Certificate

Email Contact(s):
• Gabriel Serna

Web Resource(s):
• Website

Phone Number(s):
• *Office Phone::* 540/231-5872

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://gradapp.stl.vt.edu/pages/login.php). In addition to the appropriate admission application, students must complete the Application for a Graduate Certificate (http://graduateschool.vt.edu/admissions/applying/index.html). 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 (http://graduateschool.vt.edu/admissions/applying/index.html). 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 (Fall)
EDHE 6274 – Higher Education Law (Fall)

In addition, students must complete the two courses in one of the following three tracks:

Student Development and Learning Track

EDHE 5314 – Theories of Student Development (Fall)

EDHE 5334 – The College Student and the College Environment (Spring)

Governance and Policy Track

EDHE 6084 – Financial Administration in Higher Education (Spring, Odd Numbered Years)
EDHE 6044 – Governance and Policy in Education (Spring, Even Numbered Years)

Organizations and Management Track

EDHE 6304 – Theories of Educational Organization (Fall)
EDHE 6094 – University Leadership (Summer)

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 contact Gabriel Serna, Higher Education Program, at gaserna@vt.edu.

Virginia Tech does not discriminate against employees, students, or applicants on the basis of age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, genetic information, veteran status, or any other basis protected by law. Anyone having questions concerning any of those regulations should contact the Office of Equity and Access, North End Center, 300 Turner Street NW Suite 2300 (0138), Blacksburg, VA 24061, 540-231-9331.

Homeland Security Policy
HSC

Address:
1021 Prince Street CPAP (0804) Virginia Tech
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):
• Scott Weimer

Web Resource(s):
• Website
• Certificate Website

Phone Number(s):
• *Scott Weimer:* 540/231-7887
• *Karen Hult:* 540/231-5242

Certificate Overview | Admissions & Course Requirements

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 core courses focus on 1) the threat (PAPA 5264), 2) prevention (PAPA 6264), and 3) response and recovery (PAPA 5354). A fourth course is 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. Up to 6 credit hours can be double-counted for the degree and the graduate certificate. Transfer credits are not permitted.

How to Apply:
Fill out the online application for participation in the certificate program.

Homeland Security Policy
HSC

Address:
1021 Prince Street CPAP (0804) Virginia Tech
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):
• Scott Weimer

Web Resource(s):
• Website
• Certificate Website

Phone Number(s):
• *Scott Weimer:* 540/231-7887
• *Karen Hult:* 540/231-5242

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 three required classes to receive the certificate.

Required:

- PAPA 5254 Homeland Security and the Terrorist Threat
- PAPA 6264 Advanced Topics in Policy Systems Management: Homeland Security and Prevention
- PAPA 5354 Homeland Security Response and Recovery

Electives (choose one):

- PAPA/STS 6664 Advanced Topics in Science and Technology: Complexity, Emerging Policy, Doctrine, and Reality
- PAPA 6254 Advanced Topics in Homeland Security Policy: Critical Infrastructure Protection and Resiliency
- GIA 5514 Global Security
- PAPA 5904/5974 Independent Study, Project and Report

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):

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 for students 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.

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):

Certificate Overview | Admissions & Course Requirements

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)

Human Centered Design
HCDC

Address:
Department of Computer Science 1121 VTKW II 2202 Kraft Dr #0902
Blacksburg, Virginia 24060

Contact this Certificate

Email Contact(s):
• Steve Harrison

Web Resource(s):

Phone Number(s):
• *Steve Harrison:*
540/231-7783

Certificate Overview | Admissions & Course Requirements

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. 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.

How to Apply:
Fill out the online application for participation in the certificate program.

Human Centered Design
HCDC

Address:
Department of Computer Science 1121 VTKW II 2202 Kraft Dr #0902
Blacksburg, Virginia 24060

Contact this Certificate

Email Contact(s):
• Steve Harrison

Web Resource(s):

Phone Number(s):
• *Steve Harrison:*
540/231-7783

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.

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.) NOTE: this list of classes has changed from previous years; students who have competed or were completing the certificate based on previous posted course requirements may use those courses for the certificate. If you have questions, please contact Steve Harrison, director.

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 6984: 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 course work and selection of thesis or dissertation topics.

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):
• Jon Antin, Ph.D., CHFP, Program Coordinator

Web Resource(s):
• Human Factors of Transportation Safety Graduate Certificate Program

Phone Number(s):
• *Jon Antin, Ph.D., CHFP, Program Coordinator:* 540/231-1579

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:

§ Civil and Environmental Engineering

§ Industrial & Systems Engineering

§ Psychology

§ Statistics

The HFTS Certificate Program is housed and administered within VTTI (with support from the Graduate School and the affiliated faculty of 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; 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 within affiliated departments 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 4 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):
• Jon Antin, Ph.D., CHFP, Program Coordinator

Web Resource(s):
• Human Factors of Transportation Safety Graduate Certificate Program

Phone Number(s):
• *Jon Antin, Ph.D., CHFP, Program Coordinator:* 540/231-1579

Admission Requirements

- Admission to the Graduate School
- Completing a Graduate Certificate Application are required for all students.
- Courses used for certificate 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

- **CEE 5640** Highway Transportation Safety

- **CEE 5660** Transportation Risk, Reliability, and Security

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 5594** Statistical Epidemiology and Observational Studies

- **STAT 5615/5616** - Statistics in Research

Category D: Transportation-Related Eng./ Modeling / Design

- **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.

Human Sexuality Studies
HSSC

Address:
315 Wallace Hall, 295 West Campus Dr.
Blacksburg, VA 24061

Contact this Certificate
Email Contact(s):
Web Resource(s):
Phone Number(s):

Certificate Overview | Admissions & Course Requirements

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.

Human Sexuality Studies
HSSC

Address:
315 Wallace Hall, 295 West Campus Dr.
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

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/GAAPforms/Application_Certificate.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.

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.

Human-System Integration
HSIC

Address:
VT ISE Department 250 Durham Hall (0118) Blacksburg, VA 24061
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Paula VanCuren

Web Resource(s):
• H-SI Certificate

Phone Number(s):
• *Paula Van Curen:* 540/231-2364

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.

Human-System Integration
HSIC

Address:
VT ISE Department 250 Durham Hall (0118) Blacksburg, VA 24061
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Paula VanCuren

Web Resource(s):
• H-SI Certificate

Phone Number(s):
• *Paula Van Curen:* 540/231-2364

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

ENGR 5004 Life Cycle Engineering of Complex Systems [context for HSI]

ISE 5154 Technology Enabled Human Performance [critical component of HSI]

ISE 5144 Life Cycle Measurement of System Performance [value impact of HSI]

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.

Information Assurance Engineering
IAEC

Address:
301 Whittemore Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
- Joe Tront
- Charles Clancy

Web Resource(s):
- Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Information Assurance Engineering certificate is available by taking a sequence of courses focused in information, computer, and network security from the ECE and/or CS departments at Virginia Tech. Students may take the course sequence either as stand-alone courses or as a part of a Masters or Doctorate program.

How to Apply:
Fill out the online application for participation in the certificate program.

Information Assurance Engineering
IAEC

Address:
301 Whittemore Hall
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
- Joe Tront
- Charles Clancy

Web Resource(s):
- Website

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Certificate students must complete an application form for the certificate when they enroll. The application form is similar to a POS listing the GCIAE courses to be taken and is signed by the CS/ECE department program director who administers the GCIAE program. Then they must submit a separate 'application for conferral of degree' form for the certificate by the deadline for the semester in which they are planning to finish. Grad School staff will check the transcript against the courses on the approved application.
Students who are completing a degree and a certificate at the same time must submit 2 "application for conferral of degree" forms, one for the degree and one for the certificate. If they submit both forms at the same time, they pay only one graduation fee. Certificate recipients are listed in a special section of the Commencement Bulletin and recognized as a special group during the commencement ceremony. Graduate Certificates appear on the transcript but not on the diploma. Students receive a separate Certificate, similar to a diploma at the same time as their diploma if they are degree students or at the time of the next commencement if they are Commonwealth Campus students.

Course Requirements

A student can earn a graduate certificate in Information Assurance Engineering when he/she completes the following 4 courses:
CS/ECE 5560 Fundamentals of Information Security
CS/ECE 5565 Network Architecture and Protocols
CS 5704 Software Engineering
*CS/ECE 5566 Network Architecture and Protocols II
*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.

Information Policy and Society
PIPC

Address:
Political Science (0130) Major Williams Hall, Room 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Contact
• Director of Graduate Studies

Web Resource(s):
• Website

Phone Number(s):
• *Telephone:* 540/231-6572

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This graduate certificate program in Information, Policy and Society targets non-degree-seeking students and students in the Virginia Tech MA program in Political Science who wish to demonstrate special competence in studies 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. It will recognize courses that students take 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 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Contact
• Director of Graduate Studies

Web Resource(s):
• Website

Phone Number(s):
• *Telephone:* 540/231-6572

Certificate Overview | Admissions & Course Requirements

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 5555 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

Information Security and Analytics
ISC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Information Security and Analytics

Knowledge of 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.The certificate in Information Security and Analytics introduces students to the fundamentals of computer and network security, teaches students how to analyze a client/server IT infrastructure for security weaknesses, and gives practical experience in analyzing common practices for security vulnerabilities that could result in the loss of sensitive company and customer information. It also provides the 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 certificate also examines the use of business intelligence and analytics in data rich organizations and explores the development and application of 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.

Information Security and Analytics
ISC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admissions Requirements

Prospective students wishing to complete a graduate certificate in the MIT program will apply online and submit an official transcript showing a bachelor's degree conferral from a regionally accredited university with a minimum GPA of 3.0, and a current resume.

Course Requirements

To earn the certificate in Information Security and Analytics, students must complete the following courses:

- ECE 5585-Information Security & Trust I
- ECE 5586-Information Security & Trust II
- BIT 5524-Introduction to Business Intelligence & Analytics
- BIT 5534-Advanced Business Intelligence & Analytics

Information Technology Management
ITMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, #364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Assistance:* 703/538-8384

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Management of Technology

The certificate in Management of Technology prepares students to become information technology leaders and to be able to craft corporate and business strategies where technology provides the basis for an organization's competitive advantage. Students will have an introduction to design methodologies in information systems and databases. Structured systems analysis and design methodologies as well as topics related to different database models and their implementation will be covered. An overview of the use of business intelligence and analytics technologies in rich organizations will be given and their strategic use including defining/framing the business context for decisions, a survey of the different types of decision models, data issues, business intelligence, building analytics capability, making organizations smarter, and measuring the value of analytics. Students will also learn about the characteristics, use, and development of decision support systems (DSS) within the context of other business information systems and the process of designing and implementing decision support systems in business is examined from both theoretical and practical standpoints.

How to Apply:
Fill out the online application for participation in the certificate program.

Information Technology Management ITMC

Address:
VT-MIT Program Northern Virginia Center 7054 Haycock Road, #364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• General Contact

Web Resource(s):
• Graduate Site

Phone Number(s):
• *General Assistance:* 703/538-8384

Graduate Certificate Admissions Requirements

Prospective students wishing to complete a graduate certificate in the MIT program will apply online and submit an official transcript showing a bachelor's degree conferral from a regionally accredited university with a minimum GPA of 3.0, and a current resume.

Course Requirements

To earn the certificate in Management of Technology, students must complete the following courses:

- MGT 5804-Strategic Leadership in Technology Based Organizations
- ACIS 5504- Information Systems Design and Database Concepts
- BIT 5474- Computer-Based Decision Support Systems
- BIT 5524-Introduction to Business Intelligence and Analytics

Integrative STEM Education
STMC

Address:
370 Drill Field Drive, War Memorial Hall, Room 115
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Jeremy V. Ernst

Web Resource(s):
• PDF Form

Phone Number(s):
• *Program Area Leader:* 540/231-2040

Certificate Overview

In Spring 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 and graduate certificate 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 focus on the investigation and application of new integrative approaches to STEM education 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 - 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 graduate program at Virginia Tech is conveyed in how Integrative STEM Education is operationally defined.

Integrative STEM Education is "the application of technological/engineering design based pedagogical approaches to *intentionally* teach content and practices of science and mathematics education 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 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).

How to Apply:
Fill out the online application for participation in the certificate program.

Integrative STEM Education
STMC

Address:
370 Drill Field Drive, War Memorial Hall, Room 115
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Jeremy V. Ernst

Web Resource(s):
• PDF Form

Phone Number(s):
• *Program Area Leader:* 540/231-2040

Certificate Overview | Admissions & Course Requirements

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)

EDCI 5804: STEM Education Foundations (3 SH)

EDCI 5824: STEM Education Trends and Issues (3 SH)

EDCI 5774: Readings in Technology Education (3 SH)

*Note: All coursework for this Graduate Certificate is delivered via synchronous audio/video web-based delivery.

Interdisciplinary Water and Health Science
IWHC

Address:
402D HABBI, Virginia Tech, Blacksburg
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Susan Duncan
• Dr. Andrea Dietrich
• Dr. Aili Wang

Web Resource(s):
• Water INTERface official website
• Water INTERface Blog

Phone Number(s):

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.

Interdisciplinary Water and Health Science
IWHC

Address:
402D HABBI, Virginia Tech, Blacksburg
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Dr. Susan Duncan
• Dr. Andrea Dietrich
• Dr. Aili Wang

Web Resource(s):
• Water INTERface official website
• Water INTERface Blog

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

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:

CEE 5804, Engineering Ethics and the Public (3 cr.)

GRAD 5414, Water for Health Seminar (1 cr.)

GRAD 5134, Interdisciplinary Research: Water for Health (3 cr.)

GRAD 5974 (or from the mentor's department), Independent Study (2 cr.)

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):

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 for students 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):

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)

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):
• Rosemary Blieszner
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *Rosemary Blieszner:* 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.

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):
• Rosemary Blieszner
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *Rosemary Blieszner:* 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)

Learning Sciences
LSCC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Lisa Sheppard

Web Resource(s):
• PDF Form

Phone Number(s):
• *Department of Learning Sciences and Technologies:* 540/231-5587

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. 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.

Learning Sciences
LSCC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Lisa Sheppard

Web Resource(s):
• PDF Form

Phone Number(s):
• *Department of Learning Sciences and Technologies:* 540/231-5587

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 in the Department of Learning Sciences and Technologies 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 5174: Informal Learning for School Age Youth
EDCI 6024: The Analysis of Educational Concepts
EDCI 6044: Classroom Discourse

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 Department of Learning Sciences and Technologies.

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 (http://www.graduateschool.vt.edu/forms/index.html).

Certificate Faculty

The following faculty members of the Department of the Learning Sciences are affiliated with the Graduate Certificate in the Learning Sciences:

Dr. John Burton, Department of Learning Sciences and Technologies
Dr. Katherine Cennamo, Department of Learning Sciences and Technologies
Dr. Peter Doolittle, Department of Learning Sciences and Technologies
Dr. Jim Garrison, Department of Learning Sciences and Technologies
Dr. Brett Jones, Department of Learning Sciences and Technologies
Dr. Barbara Lockee, Department of Learning Sciences and Technologies
Dr. Susan Magliaro, Department of Learning Sciences and Technologies
Dr. Ken Potter, Department of Learning Sciences and Technologies
Dr. Jocelyn Wilson, Department of Learning Sciences and Technologies

For general inquiries regarding the certificate, please contact Lisa Sheppard, Administrative Assistant for the Department of Learning Sciences and Technologies, (ldouthat@vt.edu, Room 225D, War Memorial Hall, 540-231-5587).

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):
• Certificate Website
• Program Website

Phone Number(s):
• *Stephanie Davis:* 804/980-5549
• *Laura French:* 540/231-5133

Certificate Overview | Admissions & Course Requirements

Certificate Overview

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):
• Certificate Website
• Program Website

Phone Number(s):
• *Stephanie Davis:* 804/980-5549
• *Laura French:* 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, up to six credit hours can be double-counted for the degree and the graduate certificate. Transfer credits are not permitted.

Course Requirements

Students are required to complete four courses with a GPA of 3.0 or better to earn the certificate.

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.

On-line certificate

An on-line version of the Local Government Management certificate also is available. Designed for both a national audience and for Virginia residents who are unable to take synchronous classes, the on-line certificate has the same requirements, with course content and instructors from throughout the United States.

Marriage and Family Therapy
MAFC

Address:
7054 Haycock Road Suite 202
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Patricia Meneely, Program Coordinator

Web Resource(s):
• Website

Phone Number(s):
• *Program Coordinator's Office:*
703/538-8460

Post-Master's Certificate Overview

Marriage and Family Therapy is a discipline for people who are interested in providing mental health services to individuals and families from a systems or relational perspective. This program prepares students to be family therapists who are well-grounded in systems theory and who are competent to diagnose and treat mental illness. Students have the opportunity to receive intensive supervision of their clinical work with a broad range of individuals, couples, and families at the Department's Center for Family Services. The post-master's certificate program is designed for students who already have a clinical master's degree. Students have the opportunity to take courses to prepare them for clinical membership in AAMFT and for professional licensure. While the program consists of a structured group of courses, each student will determine his or her own needs in order to supplement previous master's degree programs or to receive AAMFT Clinical Membership or licensure. The MFT post-master's certificate program encourages diversity. Members of minority groups are highly encouraged to apply.

How to Apply:
Fill out the online application for participation in the certificate program.

Marriage and Family Therapy MAFC

Address:
7054 Haycock Road Suite 202
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Patricia Meneely, Program Coordinator

Web Resource(s):
• Website

Phone Number(s):
• *Program Coordinator's Office:*
703/538-8460

Admission Requirements

Applicants for the Post-Master's Certificate in Marriage and Family Therapy Program must hold bachelor's and master's degrees from an accredited institution and present evidence of ability to do graduate level work, including a quality credit average of 3.0 on a 4.0 scale. Original transcripts, 3 letters of reference and a supplemental application are required in addition to the Virginia Tech on-line application. Potential students must also demonstrate that they have some professional or volunteer experience in a clinical setting.

Course Requirements

COURSEWORK

The program consists of advanced courses in marriage and family therapy and a supervised clinical practicum. A total of 21-24 post-master's credits must be earned for completion of the program. The program may be pursued on a part-time or full-time basis. Courses are offered during the day.

There are 5-6 academic courses (15-18 hours) required for the Post-Master's Certificate Program.

The required academic courses are:

HD 5404 Systems Theory and Family Therapy

HD 5434 Clinical Marriage and Family Therapy I (Structural and
Strategic Approaches

HD 5474 Professional Seminar in Marriage and Family Therapy (Ethics)
(this course may be waived if the student has taken a course in
professional ethics in his/her previous graduate work)

Choose three of the following courses depending on areas of interest:

HD 5724 Couples Therapy

HD 5344 Perspectives on Human Sexuality

HD 5424 Life-Span Human Development

HD 5444 Clinical Marriage and Family Therapy II (Constructivist
Approaches)

HD 5454 Clinical MFT III (Diagnosis and Treatment in the Family

Context)

HD 5464 Clinical Marriage and Family Therapy IV (Special Topics in

MFT)

HD 5744 Multicultural Family Therapy

Or any additional department courses available

Material Culture and Public Humanities MCHC

Address:
203 Draper Road
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Aaron Ansell
• Bailey Van Hook

Web Resource(s):
• Material Culture & Public Humanities

Phone Number(s):
• *Elizabeth Fine:* 540/231-0491
• *Bailey Van Hook:* 540/231-5547

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Material Culture and Public Humanities

This is a cross-disciplinary graduate certificate that provides opportunities for students in other graduate programs to take advantage of key courses in the MA program on Material Culture and Public Humanities. *Material culture* is the study of material or physical objects, as well as the placement of those objects in critical, theoretical and historical perspectives as the products of distinct cultures. *Public humanities* bridges the divide between academia and the public by encouraging dialogue between scholars and communities on cultural and social issues.

Both the MA and the graduate certificate have two interrelated emphases (material culture and public humanities) that share common intellectual issues and employment goals. Courses in this graduate certificate program offer students the opportunity to interpret material culture (e.g., physical objects; historical artifacts) within informed historical / cultural frameworks and articulate their significance to the public. The certificate enables graduate students in the target population of architecture, interior design, history, communication, rhetoric, sociology, STS, and ASPECT better to compete for jobs in museums, historical societies, and community and cultural organizations.

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
• Bailey Van Hook

Web Resource(s):
• Material Culture & Public Humanities

Phone Number(s):
• *Elizabeth Fine:* 540/231-0491
• *Bailey Van Hook:* 540/231-5547

Admission Requirements

Graduate standing at Virginia Tech (including those accepted by the Graduate School as Commonwealth Scholars) and an essay demonstrating interest in or experience related to a certificate in Material Culture and Public Humanities. Students seeking admission to the certificate program should consult with the Graduate Director or a member of the Steering Committee for the MA in Material Culture and Public Humanities.

Course Requirements

The certificate requires 9 credit hours, distributed as follows:

Required:

· 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.

· HUM/RLCL 5304: 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.

One elective chosen 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.

· ITDS 5124: Preservation of Historic Interiors (3H, 3C)

Study of restoration and preservation practices, including economic, social, and legal aspects and an introduction to historical research methodology.

- 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 inhibits, documentary films, photographic collections, community history projects, the Internet, and a variety of other public venues.

Metropolitan Studies
METC

Address:
1021 Prince St, Suite 200
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):
• Kris Wernstedt

Web Resource(s):
• Website

Phone Number(s):
• *Myriam Lechuga:* 703/706-8111

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The Graduate Certificate in Metropolitan Studies is designed for those who are interested in acquiring a basic understanding of metropolitan development dynamics and the role of policy in influencing them. The certificate is part of the Urban Affairs and Planning program's overall mission to teach students how to understand, analyze, and influence the forces that shape the metropolitan built environment.

The target population includes current Virginia Tech and other graduate students in all fields, and others with undergraduate degrees who qualify for admission to the certificate program (including those who currently are not degree-seeking VT students).

How to Apply:
Fill out the online application for participation in the certificate program.

Metropolitan Studies
METC

Address:
1021 Prince St, Suite 200
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):
• Kris Wernstedt

Web Resource(s):
• Website

Phone Number(s):
• *Myriam Lechuga:* 703/706-8111

Admission Requirements

Admission to the Certificate Program requires status as a current graduate student in good standing in Virginia Tech. If not currently such a student then application as a non-degree certificate student is necessary. A minimum undergraduate grade point average of 3.0 for this category is needed. Exceptions include achieving this minimum based on the last 60 semester hours of coursework or Commonwealth Campus admission if the GPA is above 2.75 but below 3.00. Official transcripts must be submitted. Application requirements are posted on Virginia Tech's Graduate School web site.

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 who are not enrolled in the MURP degree program must complete at least six credit hours from among the following core certificate courses plus six credit hours in electives.
Core: Six credit hours from among:
UAP 5104: Urban & Regional Development Theory
UAP 5174: Theory & Practice of Urban & Regional Planning
UAP 5194: Urban Growth Management
UAP 5234: Urban Economy & Public Policy
Electives: Six credit hours from among other UAP courses including those not used for the core noted above, as approved by the faculty.

Students seeking the Certificate who are enrolled in the MURP degree program must complete the following two core certificate courses plus six credit hours in electives.
Core: Six core credit hours from:
UAP 5104: Urban & Regional Development Theory
UAP 5194: Urban Growth Management
Electives: Six credit hours from among other UAP courses not used for the core noted above and not appearing on the MURP plan of study, as approved by the faculty.

All courses used for the Certificate must be graded on an A-F basis. All courses also must be taken from Virginia Tech's Urban Affairs and Planning Program.

Middle East Politics and Society
MEPC

Address:
1021 Prince Street, School of Public and International Affairs, Virginia Tech
Alexandria Ctr
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):

Web Resource(s):

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:
1021 Prince Street, School of Public and International Affairs, Virginia Tech
Alexandria Ctr
Alexandria, VA 22314

Contact this Certificate

Email Contact(s):

Web Resource(s):

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

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.

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):
• Betty Watts

Web Resource(s):
• website

Phone Number(s):
• *phone:* 540/231-7220

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):
• Betty Watts

Web Resource(s):
• website

Phone Number(s):
• *phone:* 540/231-7220

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 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

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

Graduate Certificate in Natural Resources (GCNR) Overview

This 12-credit graduate certificate is designed for students and professionals seeking graduate-level education and training in environmental and natural resource management. Students pursuing this certificate must complete 9 of the 12 credits with courses offered in the MNR program, including Conservation Ecology (NR 5724). The Graduate Certificate in Natural Resource Management is a good option for professionals seeking credentials in environmental and natural resource management.

Beyond the 9 credit hours that must be earned in courses offered through the MNR program, the remaining 3 credit hours may be earned in approved courses outside of the MNR program, including (but not limited to) courses offered as part of the Master of Landscape Architecture (MLA), Master of Urban and Regional Planning (MURP), and the Online Master of Arts in Political Science programs at Virginia Tech. Students must maintain a GPA of 3.0 or above for those 12 credit hours.

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

GCNR Admission Requirements

Students can apply for the GCNR as a degree-seeking student, non-degree-seeking 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

Course Requirements

The GCNR can be completed in a single academic term or over the course of several semesters. Many students go on to complete a Master of Natural Resources degree since 50% of their GCNR coursework can also be applied to the MNR degree requirements. 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)

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

Certificate Overview | Admissions & Course Requirements

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

AOE 5304: Advanced Naval Architecture (3 credits)*

AOE 5305: Marine Engineering (3 credits)**

AOE 5314: Naval Ship System Design and Effectiveness (3 credits)***

* May substitute AOE 5334: Advanced Dynamics if Naval Architecture was taken previously as an undergraduate or other.

** May substitute AOE 5074: Advanced Ship Structural Analysis if Marine Engineering was taken previously as an undergraduate or other.

*** It is strongly recommended that prior to taking AOE 5314: Naval Ship System Design and Effectiveness, students first take AOE 4264: Principles of Naval Engineering.

Nonprofit and Nongovernmental Organization Management NNMC

Address:
Virginia Tech, National Capital Region 900 North Glebe Road
Arlington , Virginia 22203

Contact this Certificate

Email Contact(s):
• Anne Khademian
• Amanda Fawkes

Web Resource(s):
• VTO Website
• SPIA Website
• VTIPG Website

Phone Number(s):
• *Anne Khademian, SPIA Director:*
703/706-8119
• *Amanda Fawkes:*
804/464-8355

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The School of Public and International Affair's graduate certificate in Nonprofit and Nongovernmental Organization Management serves graduate students in NCR and Blacksburg and working professionals in both nonprofits/NGOs and the public sector. The certificate fosters the development of students by offering a streamlined curriculum focusing on the seamlessness between international and domestic environments, engaged pedagogy, reflexivity, and collaborative learning.

How to Apply:
Fill out the online application for participation in the certificate program.

Nonprofit and Nongovernmental Organization Management NNMC

Address:
Virginia Tech, National Capital Region 900 North Glebe Road
Arlington , Virginia 22203

Contact this Certificate

Email Contact(s):
• Anne Khademian
• Amanda Fawkes

Web Resource(s):
• VTO Website
• SPIA Website
• VTIPG Website

Phone Number(s):
• *Anne Khademian, SPIA Director:* 703/706-8119
• *Amanda Fawkes:* 804/464-8355

Certificate Overview | Admissions & Course Requirements

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

Students are required to take four out five of the following courses:

- **SPIA 5514 - Nongovernmental Organizations in International Development** (offered on Blacksburg campus and online) 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 5544 - Public and Nonprofit Financial Management** (offered only online) 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 5574 - Nonprofit Organization and Management** (offered on Blacksburg campus and online) 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. Challenges facing domestic nonprofits compared to those found in nongovernmental organizations across the globe.

- **SPIA 5534 - Nonprofit Organization Leadership** (offered on Blacksburg campus and online) 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 5524 - Nonprofit Accountability and Evaluation** (offered only online) 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.

Nuclear Engineering
NEC

Address:
Mechanical Engineering Department 445 Signature Engineering Building (MC 0238) 635 Prices Fork Road
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Mark Pierson
• Cathy Hill

Web Resource(s):
• Mechanical Engineering

Phone Number(s):
• *Mark Pierson:*
540/231-9112
• *Cathy Hill:*
540/231-7460

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The primary purposes of the Nuclear Engineering Certificate are to (1) provide a purposeful, cohesive set of technical electives in nuclear engineering; and (2) facilitate networking among faculty, students, and employers in nuclear engineering applications. The certificate is useful in transitioning from a non-nuclear engineering-related job to a nuclear engineering-related job. The Nuclear Engineering Certificate will also make those who do not have a nuclear engineering degree more competitive in applying for 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.

Nuclear Engineering
NEC

Address:
Mechanical Engineering Department 445 Signature Engineering Building (MC 0238) 635 Prices Fork Road
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Mark Pierson
• Cathy Hill

Web Resource(s):
• Mechanical Engineering

Phone Number(s):
• *Mark Pierson:* 540/231-9112
• *Cathy Hill:* 540/231-7460

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Enrolled in the Graduate School through either a degree program or non-degree program. Applicants who have earned or will earn a B.S. degree in an engineering or science-related discipline are encouraged to have a 3.2 (4.0 scale) or higher GPA on their most recent 60 course credit hours during their undergraduate education. However, a minimum gpa of 2.8 (4.0 scale) will be considered for admission for Commonwealth Campus applicants. No GRE test scores are required.

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 semester. Only a maximum of 3 credit-hours total may be taken of either NSEG 5974 or NSEG 5984.

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 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 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 of either NSEG 5974 or NSEG 5984 w/ approval of program coordinator*

Location

The Nuclear Engineering Program is located at:
Mechanical Engineering Department (MC 0238), 455 Goodwin Hall, 635 Prices Fork Road, Blacksburg, VA 24061

and at

Virginia Tech Research Center
National Capital Region
900 N. Glebe Road
Arlington, VA 22203

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 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

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

Problem Solving for Leading Change
PSLC

Address:
214 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

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 completely independent of intelligence. 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 leaders, and we are all agents of change.

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.

Problem Solving for Leading Change
PSLC

Address:
214 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

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 sequentially so that students may complete the Graduate Certificate in Problem Solving in four academic terms. For example:

- Fall - LDRS 5534: Cognition, Problem Solving, and Preferences for Change
- Spring - LDRS 5544: Leading Teams through Change
- Summer - LDRS 5554: Leading Social Change
- Fall - LDRS 5904: Project and Report

Public Health
PHLC

Address:
205 Duck Pond Drive, Room 332
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Kerry J. Redican, MPH, PhD, CHES

Web Resource(s):
• http://www.mph.vetmed.vt.edu

Phone Number(s):
• *540-231-5743:* 540/231-5743

Certificate Overview | Admissions & Course Requirements

Certificate in Public Health (Online)

The Online graduate Certificate in Public Health (18 credits) includes the core courses in the Master of Public Health (MPH) program offered by the Department of Population Health Sciences in the College of Veterinary Medicine. A Certificate in Public Health will be helpful to non-degree seeking students who have completed an undergraduate degree and want to demonstrate competence in public health. Also, the Certificate in Public Health will provide the content background for those professionals desiring to sit for the Certified in Public Health (CPH) exam.

How to Apply:
Fill out the online application for participation in the certificate program.

Public Health
PHLC

Address:
205 Duck Pond Drive, Room 332
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Kerry J. Redican, MPH, PhD, CHES

Web Resource(s):
• http://www.mph.vetmed.vt.edu

Phone Number(s):
• *540-231-5743:* 540/231-5743

Certificate in Public Health Admission Requirements

Admission to the Graduate School and completing a Graduate Certificate Application are required for both degree- and non-degree seeking students.

***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 http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/certificate_application.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.**

***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.

- **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.**

Certificate in Public Health Requirements

Requirements: Completion the following 18 credits. Transfer credits are not permitted.

PHS 5004 – Fundamentals of Public Health

PHS 5014 – Environmental Health

PHS 5025 – Epidemiology and Quantitative Methods in Public Health I

PHS 5026 – Epidemiology and Quantitative Methods in Public Health II

PHS 5034 – Health Behavior and Health Education

PHS 5044 – Public Health Administration

(CIP 51.2201)

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

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

Certificate Overview | Admissions & Course Requirements

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

Public and Nonprofit Financial Management
PNPC

Address:
Thomas Conner House 104 Draper Road
Blacksburg, Virginia 24060

Contact this Certificate

Email Contact(s):
• Stephanie Davis

Web Resource(s):
• website
• Program website

Phone Number(s):
• *Stephanie Davis:* 804/980-5549

Certificate Overview | Admissions & Course Requirements

Certificate Overview

The graduate certificate in Public and Non-profit Financial Management is designed to develop students' and professional financial managers' understanding of the concepts and practice of financial management in the public and nonprofit sectors. 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.

As public service organizations continue to face financial difficulties, financial mastery can no longer simply be the sole purview of accountants and other specially trained individuals. In the new public service landscape, financial competency is a must for all employees, and financial mastery is increasingly a pre-requisite for high-level positions in public service organizations. Available throughout 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 will demand 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. Classroom discussion and both group and individual assignments simulate real work scenarios and prepare students for real life application.

How to Apply:
Fill out the online application for participation in the certificate program.

Public and Nonprofit Financial Management
PNPC

Address:
Thomas Conner House 104 Draper Road
Blacksburg, Virginia 24060

Contact this Certificate

Email Contact(s):
• Stephanie Davis

Web Resource(s):
• website
• Program website

Phone Number(s):
• *Stephanie Davis:* 804/980-5549

Admission Requirements

Non-degree candidates may apply for admission to graduate study using the Virginia Tech Graduate School's online application system 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 to the Virginia Tech Graduate School as part of the application process.

Degree and non-degree candidates must submit the Application for Graduate Certificate form to the Graduate School.

Course Requirements

All students must complete SPIA 5024 and at least three of the other four courses listed below for a total of 12 hours of graduate coursework. Students are required to complete four courses with a GPA of 3.0 or better in order to earn the certificate.

Required:

- PAPA/SPIA 5024 Overview of Public and Nonprofit Financial Management

Three of the following:

- PAPA/SPIA 5694 Capital and Debt Financial Management for Public and Nonprofit Organizations
- PAPA/SPIA 5674 Financial Health of Public and Nonprofit Organizations
- SPIA 5544 Public and Nonprofit Financial Management
- PAPA 6314 Budgeting for Performance Management and Outcomes for PUblic and Nonprofit Organizations

Quantitative Resource Assessment QRAC

Address:

Blackshurg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• PDF Form

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Certificate Overview

How to Apply:
Fill out the online application for participation in the certificate program.

Quantitative Resource Assessment QRAC

Address:

Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):
• PDF Form

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Course Requirements

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**

Religious Studies
RSC

Address:
111 Lane Hall, Virginia Tech
Blacksburg, VA 24061-0227

Contact this Certificate

Email Contact(s):
• Brian Britt

Web Resource(s):
• Website

Phone Number(s):
• *Department of Religion and Culture:* 540/231-5118

Certificate Overview

The graduate certificate in Religious Studies serves students in several master's and doctoral programs at Virginia Tech, including Material Culture and Public Humanities, Political Science, English, and the Alliance for Social, Political, Ethical, and Cultural Thought (ASPECT).

Graduate courses for this certificate emphasize questions of method and theory shared by many of these programs. The certificate gives students in these programs a way to formalize their academic interest in religion; such a credential would enhance their ability to apply for teaching, research, and policy positions that involve the study of religion.

A second population of students served by the certificate are non-degree-seeking students who wish to enhance their understanding of religion for professional or personal reasons. Primary and secondary school teachers, for instance, will find our courses useful in navigating the increasingly diverse religious terrain of their students and colleagues.

How to Apply:
Fill out the online application for participation in the certificate program.

Religious Studies RSC

Address:
111 Lane Hall, Virginia Tech
Blacksburg, VA 24061-0227

Contact this Certificate

Email Contact(s):
• Brian Britt

Web Resource(s):
• Website

Phone Number(s):
• *Department of Religion and Culture:* 540/231-5118

Admission Requirements

Candidates for the certificate should possess an undergraduate degree and meet the admission requirements of the Graduate School. Commonwealth Campus students and students who have Dual Status are also eligible for admission.

Course Requirements

The certificate requires the completion of 9 credit hours of work through the Department of Religion and Culture and other departments at Virginia Tech. No transfer credits are permitted.

Two of the following are required (all are 3H, 3C):

RLCL 5114 The Bible and US Public Schools

RLCL 5124 (ASPT 5124) Religion & Modernity in the West

RLCL 5134 (ASPT 5134) Islamic Political Thought

RLCL 6024 (ASPT 6024) Major Figures in Contemp. Religious Thought

Elective Courses may be chosen from the following:

1. The list above
2. Another 5000-level or 6000-level course subject to approval by the certificate candidate's advisor. *Please be sure to check course listings for special studies in RLCL, as well as ASPECT courses dealing with the subject of religion.*

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
• Wayne A. Scales
• Valerie A. Thomas
• Joseph B. Baker

Web Resource(s):
• Remote Sensing IGEP

Phone Number(s):
• *Randolph H. Wynne:* 540/231-7811
• *Wayne A. Scales:* 540/231-5622
• *Valerie A. Thomas:* 540/231-0958
• *Joseph B. Baker:* 540/231-3355

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
• Wayne A. Scales
• Valerie A. Thomas
• Joseph B. Baker

Web Resource(s):
• Remote Sensing IGEP

Phone Number(s):
• *Randolph H. Wynne:* 540/231-7811
• *Wayne A. Scales:* 540/231-5622
• *Valerie A. Thomas:* 540/231-0958
• *Joseph B. Baker:* 540/231-3355

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. Four required courses (10 credit hours total) will be mandatory for all students in the program. These four mandatory courses will ensure that all students, regardless of disciplinary background, will be exposed to the same research approach. 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: (10 mandatory credit hours)

• Remote Sensing Engineering Principles (ECE 5194, I, 3H, 3C)

• Remote Sensing of Natural Resources (FOR 5254, II, 3H, 3C)*

• 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

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):
• Rosemary Blieszner
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *Rosemary Blieszner:* 540/231-5645
• *Graduate School Admissions:* 540/231-8636

Certificate Overview | Admissions & Course Requirements

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.

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):
• Rosemary Blieszner
• Graduate School Admissions

Web Resource(s):
• Website

Phone Number(s):
• *Rosemary Blieszner:* 540/231-5645
• *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

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 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
Blackburg, 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 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

Security Studies
PSOC

Address:
Political Science (0130) Major Williams Hall Room 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Contact
• Director of Graduate Studies

Web Resource(s):
• Website

Phone Number(s):
• *Telephone:* 540/231-6572

Certificate Overview | Admissions & Course Requirements

Certificate Overview

This graduate certificate program in Security Studies targets non-degree-seeking students and students in the Virginia Tech MA program in Political Science 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. It will recognize courses that concentrate in the area of security studies.

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 531 220 Stanger Street
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Contact
• Director of Graduate Studies

Web Resource(s):
• Website

Phone Number(s):
• *Telephone:* 540/231-6572

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
- PSCI 5534 - Regionalism and Political Development

Software Development
SWDC

Address:
Master of Information Technology Program 7054 Haycock Rd., Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Terry HInders

Web Resource(s):

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Graduate Certificate in Software Development

The purpose of the Graduate Certificate in Software Development 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.

How to Apply:
Fill out the online application for participation in the certificate program.

Software Development SWDC

Address:
Master of Information Technology Program 7054 Haycock Rd., Ste. 364
Falls Church, VA 22043

Contact this Certificate

Email Contact(s):
• Terry HInders

Web Resource(s):

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Prospective students wishing to complete a graduate certificate in the MIT program will apply online and submit an official transcript showing a bachelor's degree conferral from a regionally accredited university with a minimum GPA of 3.0, and a current resume. Applications accepted fall, spring, summer 1 terms.

Curriculum Requirements

Number of Credit Hours:

A total of twelve credit hours are required. Transfer credits are not permitted.

Required Courses:

CS 5044: Object-Oriented Programming with Java

CS 5244: Web Applications Development

CS 5704: Software Engineering

CS 5744: Software Design & Quality

Special Education Administration and Supervision
SEAC

Address:
226 War Memorial Hall (0313)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Carol S. Cash, Ed.D, Program Leader

Web Resource(s):

Phone Number(s):
• *VT Richmond Center:* 804/662-7288

Certificate Overview | Admissions & Course Requirements

On-line Certificate in Special Education Administration

This certificate provides information regarding current issues, legal and regulatory updates, and best-practices for leadership in the special education area. The target audience for the certificate is individuals who already hold licensure as school administrators and need specific training in special education administration. Assistant principals and other early career school administrators are often tapped to oversee special education programs. Superintendents and building level administrators consistently identify special education as an area in which they feel least confident and in which they need more training. Current special education administrators who wish to update their skills may enroll in the program. The program is not targeted toward teachers generally, but is open to teachers in leadership positions. Additionally, the certificate program is not a licensure program.

How to Apply:
Fill out the online application for participation in the certificate program.

Special Education Administration and Supervision
SEAC

Address:
226 War Memorial Hall (0313)
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Carol S. Cash, Ed.D, Program Leader

Web Resource(s):

Phone Number(s):
• *VT Richmond Center:* 804/662-7288

Certificate Overview | Admissions & Course Requirements

Admission requirements

In order to be admitted to this certificate program, the candidate must have licensure in school administration or a teaching certificate in special education. Other students holding a teaching certificate may be considered on a case-by-case basis. A specific undergraduate GPA beyond the minimum set by the Graduate School is not required for admission and the GRE is not required.

Course Requirements

This certificate requires the completion of the following three courses. Courses may be taken in any sequence, but the certificate requires the completion of all three.

EDEL 5064 Issues in Special Education

This course focuses on current issues related to meeting the needs of students with disabilities, including increased diversity, research on best practices, identification and service components and effective delivery models; the other courses focus on the background and skills for the administration of a Special Ed program within a school system and the legal requirements of managing a Special Ed program. Upon completion of all three courses, the administrator or experienced teacher will have the needed grounding in all aspects of administering a Special Ed program in a P-12 school system.

EDEL 5074 Issues in Special Education Programs

This course focuses on background and skills for the administration of a Special Ed program within a school system; the other courses focus on the background and current issues related to meeting the needs of students with disabilities and the legal requirements of managing a Special Ed program. Upon completion of all three courses, the administrator or experienced teacher will have the needed grounding in all aspects of administering a Special Ed program in a P-12 school system.

EDEL 5084 Legal & Regulatory Issues in Special Education

The course is targeted to administrators who need either a fundamental understanding of the legal aspects or an updated understanding of the legal aspects of special education. It is also appropriate to other teacher leaders. The coursework is an extension of undergraduate work in special education and/or administrative graduate work for endorsement; it is only available to students who have completed an undergraduate degree. This course requires a student to work independently, and to develop an extensive understanding of the laws and regulations that govern special education. In order to effectively coordinate special education services with school reform and in accordance with current legal requirements, the student must be able to synthesize existing research on legal implications, research-based effective practices and appropriate delivery models for services.

Technology Management
TMC

Address:
VT ISE Department 250 Durham Hall (0118) Blacksburg, VA
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Paula VanCuren

Web Resource(s):
• TM Certificate

Phone Number(s):
• *Paula VanCuren:* 540/231-2364

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, 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):
• Paula VanCuren

Web Resource(s):
• TM Certificate

Phone Number(s):
• *Paula VanCuren:* 540/231-2364

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

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.

Traffic Control and Operations
TCOC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
- Off-campus: Beth Lucas
- On-campus: Lisa K. Burns

Web Resource(s):
- Website

Phone Number(s):
- *Blacksburg Campus:* 540/231-6069
- *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Traffic Control and Operations - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Traffic Control and Operations TCOC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Off-campus: Beth Lucas
• On-campus: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School “certificate seeking” application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called “Application for Certificate” and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the

changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

2. CEE students and non-degree-seeking students must complete the Application for Degree or Certificate Conferral form online in Hokie SPA by the deadline for the semester you will complete your certificate program. You will find the ADCC form under the Graduate Student Degree Menu/Application for Degree section of Hokie SPA.

3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called “Graduate Certificate Application” to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

Main Blacksburg Campus contacts :

Graduate Student Coordinator
Lisa K. Burns, lkburns@vt.edu, (540)-231-6069

Director of International & Graduate Education:
Lindy Cranwell, lindycra@vt.edu, (540) 231-7296

CEE Graduate Director:
Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:
Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Traffic Control and Operations

Traffic Control and Operations

Student must complete three of the following courses:

- CEE 5640:Highway Transportation Safety
- CEE 5604: Traffic Characteristics and Flow
- CEE 5634: Analysis and Planning of Mass Transit Systems
- CEE 5670: Applied Traffic Engineering Analysis
- CEE 5694: Traffic Signal Systems Operation and Control

The fourth course may be from the above list or those listed below:

- CEE 5624: Transportation Planning and Land Use
- CEE 5754: Pavement and Bridge Management Systems
- An Approved Technical Elective Course

Transportation Systems Engineering
TSEC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200
Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Transportation Systems Engineering - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Transportation Systems Engineering
TSEC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200
Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School “certificate seeking” application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called “Application for Certificate” and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than

outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

2. CEE students and non-degree-seeking students must complete the Application for Degree or Certificate Conferral form online in Hokie SPA by the deadline for the semester you will complete your certificate program. You will find the ADCC form under the Graduate Student Degree Menu/Application for Degree section of Hokie SPA.

3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called “Graduate Certificate Application” to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

Main Blacksburg Campus contacts :

Graduate Student Coordinator
Lisa K. Burns, lkburns@vt.edu, (540)-231-6069

Director of International & Graduate Education:
Lindy Cranwell, lindycra@vt.edu, (540) 231-7296

CEE Graduate Director:
Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:
Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Transportation Systems Engineering

Transportation Systems Engineering

Student must complete three of the following courses:

- CEE 5624: Transportation Planning and Land Use
- CEE 5634: Analysis and Planning of Mass Transit Systems
- CEE 5614: Analysis of Air Transportation Systems
- CEE 5604: Traffic Characteristics and Flow
- CEE 5670: Applied Traffic Engineering Analysis

The fourth course may be from the above list or those listed below:

- CEE 5640: Highway Transportation Safety
- CEE 5694: Traffic Signal Systems Operation and Control
- CEE 5600: Civil Infrastructure Systems Analysis
- CEE 5754: Pavement and Bridge Management Systems
- An Approved Technical Elective Course

Treatment Process Engineering
TPEC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Treatment Process Engineering - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Treatment Process Engineering
TPEC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School "certificate seeking" application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called "Application for Degree or Certificate Conferral" through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called "Application for Certificate" and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called "Application for Degree or Certificate Conferral" through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the

changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

2. CEE students and non-degree-seeking students must complete the Application for Degree or Certificate Conferral form online in Hokie SPA by the deadline for the semester you will complete your certificate program. You will find the ADCC form under the Graduate Student Degree Menu/Application for Degree section of Hokie SPA.

3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called "Graduate Certificate Application" to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

Main Blacksburg Campus contacts :

Graduate Student Coordinator

Lisa K. Burns, lkburns@vt.edu, (540)-231-6069

Director of International & Graduate Education:

Lindy Cranwell, lindycra@vt.edu, (540) 231-7296

CEE Graduate Director:

Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:

Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Treatment Process Engineering

Treatment Process Engineering

Students must complete four of the following courses:

- CEE 5104: Environmental Chemistry
- CEE 5794: Environmental Engineering Principles
- CEE 5125: Environmental Engineering Design I
- CEE 5126: Environmental Engineering Design II
- CEE 5174: Industrial Waste Treatment
- CEE 5194: Environmental Engineering Microbiology
- An Approved Technical Elective Course

Urban Computing
UCC

Address:
Torgersen Hall, Suite 3160
Blacksburg, VA 24061

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.

Urban Computing
UCC

Address:
Torgersen Hall, Suite 3160
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):

Web Resource(s):

Phone Number(s):

Certificate Overview | Admissions & Course Requirements

Admission Requirements

Course Requirements

Urban Hydrology and Stormwater Management UHSC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Urban Hydrology and Stormwater Management - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Urban Hydrology and Stormwater Management UHSC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School “certificate seeking” application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called “Application for Certificate” and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called “Application for Degree or Certificate Conferral” through Hokie SPA. If students have taken different courses than

outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

2. CEE students and non-degree-seeking students must complete the Application for Degree or Certificate Conferral form online in Hokie SPA by the deadline for the semester you will complete your certificate program. You will find the ADCC form under the Graduate Student Degree Menu/Application for Degree section of Hokie SPA.

3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called "Graduate Certificate Application" to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

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Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:
Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Urban Hydrology and Stormwater Management

Urban Hydrology and Stormwater Management

All students must complete CEE 5734: Urban Hydrology and Stormwater Management.

The remaining three courses must be selected from those listed below:

- CEE 5204:GIS Applications in Civil Engineering
- CEE 5304: Environmental Fluid Mechanics
- CEE 5324: Advanced Hydrology
- CEE 5714: Surface Water Quality Modeling
- CEE 5794: Environmental Engineering Principles
- CSES 5864: Advanced Wetland Soils and Mitigation
- An Approved Technical Elective Course

Water Quality Management WQMC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
- Extended Campuses: Beth Lucas
- Blacksburg: Lisa K. Burns

Web Resource(s):
- Website

Phone Number(s):
- *Blacksburg Campus:* 540/231-6069
- *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Water Quality Management - Certificate Overview

The Charles E. Via, Jr. Department of Civil and Environmental Engineering (CEE) coordinates the administration of seven graduate certificates. In the field of Advanced Transportation Systems, three certificates are available: Air Transportation Systems, Traffic Control and Operations, Transportation Systems Engineering. Related to Environmental Engineering, three certificates are available: Treatment Process Engineering, Water Quality Management, and Urban Hydrology and Stormwater Management. The certificate in Civil Infrastructure Systems encompasses a variety of CEE disciplines with emphasis in Infrastructure Engineering.

How to Apply:
Fill out the online application for participation in the certificate program.

Water Quality Management WQMC

Address:
Virginia Tech Civil & Environmental Engineering 750 Drillfield Dr. 200 Patton Hall, MC: 0105
Blacksburg, VA 24061

Contact this Certificate

Email Contact(s):
• Extended Campuses: Beth Lucas
• Blacksburg: Lisa K. Burns

Web Resource(s):
• Website

Phone Number(s):
• *Blacksburg Campus:* 540/231-6069
• *Extended Campuses:* 540/231-4595

Certificate Overview | Admissions & Course Requirements

Admission Requirements

The Graduate Certificate Program in CEE is open to both on-campus (Blacksburg) and off-campus students, full-time and part-time, who have been approved by the Virginia Tech Graduate School to take graduate coursework, including Commonwealth Campus students. Students interested in pursuing a certificate must first complete the following steps based on their current status:

Non-degree seeking VT students or individuals currently without a graduate status at VT

1. Complete the electronic Virginia Tech Graduate School "certificate seeking" application available at **https://applyto.graduateschool.vt.edu**. Applicants should apply before beginning the certificate program if they are already in a non-degree status at VT, but must apply no less than six months prior to completion of coursework. The application requires students to outline the classes they anticipate completing for the certificate (use the list of acceptable courses below). Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called "Application for Degree or Certificate Conferral" through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

VT students already seeking a graduate degree

1. Students must complete the form called "Application for Certificate" and submit to the CEE department. The application form requires students to outline the classes they anticipate completing for the certificate. Applicants should apply before beginning the certificate program, but must apply no less than six months prior to completion of coursework. Students taking appropriate courses toward the certificate program prior to the application for certificate are not guaranteed admission to the certificate program. Applicants will be notified by letter if they are admitted into the certificate program.

2. If admitted, meet with a CEE academic advisor to confirm a final semester and coursework plan for completion of the certificate. See below for a list of contacts.

3. At the beginning of the semester for the final certificate course, students should submit the form called "Application for Degree or Certificate Conferral" through Hokie SPA. If students have taken different courses than outlined in the original application, they must complete the following form to receive approval for the

changes: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf

Course Requirements

Students who wish to complete the Graduate Certificate Program in CEE must:

1. Complete 12 hours from the course requirements listed below. Note that grades for certificate courses must be a C or higher and overall certificate GPA must be 3.0 or higher. No 4000 level classes may be used as an elective course.

2. CEE students and non-degree-seeking students must complete the Application for Degree or Certificate Conferral form online in Hokie SPA by the deadline for the semester you will complete your certificate program. You will find the ADCC form under the Graduate Student Degree Menu/Application for Degree section of Hokie SPA.

3. If the outlined courses for your planned certificate have changed from the time you originally applied for the certificate program, submit a new version of the form called "Graduate Certificate Application" to the CEE Department by the third week of class in the semester you plan to finish your certificate. The link to this form can be found here: http://graduateschool.vt.edu/content/dam/graduateschool_vt_edu/Application_Certificate.pdf.

Limitations (All students, independent of major)

1. A graduate student may only receive one graduate certificate within the completion of the degree requirements for a graduate degree within the CEE Department.

2. No hours can be transferred from institutions other than Virginia Tech.

3. No credits below 5000 level may be used to satisfy the requirements.

4. Course substitutions for those not on the lists below without prior approval by the CEE Graduate Director are prohibited.

5. On-campus, degree-seeking students may only count 6 of the 12 credit hours from the certificate course requirements toward their degree.

6. Non-degree-seeking students in the certificate program who are later admitted to degree-seeking status may count all 12 credit hours toward both their certificate requirements and degree requirements.

Departmental Contacts

Main Blacksburg Campus contacts :

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Lisa K. Burns, lkburns@vt.edu, (540)-231-6069

Director of International & Graduate Education:

Lindy Cranwell, lindycra@vt.edu, (540) 231-7296

CEE Graduate Director:

Mark Widdowson, mwiddows@vt.edu, (540) 231-7153

Certificate Coordinator/Extended Campuses:

Beth Lucas, blucas06@vt.edu, (540) 231-4595

Faculty Program Advisor:

Bill Knocke, knocke@vt.edu, (540) 231-6635

Specific Courses for Certificates in Water Quality Management

Water Quality Management

All students must complete CEE 5134: Engineering Aspects of Water Quality.

The remaining three courses must be selected from those listed below:

- CEE 5104: Environmental Chemistry
- CEE 5124: Fundamentals of Environmental Toxicology
- CEE 5194: Environmental Engineering Microbiology
- CEE 5714: Surface Water Quality Modeling
- CEE 5734:Urban Hydrology and Stormwater Management
- CEE 5794: Environmental Engineering Principles
- BSE 5404: Agricultural Non-point Source Pollution
- An Approved Technical Elective Course

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

Women's & Gender Studies
WGSC

Address:
507 McBryde Hall (0137) Virginia Tech
Blacksburg, VA 24061-0137

Contact this Certificate

Email Contact(s):
• Director

Web Resource(s):
• Website

Phone Number(s):
• *Main Office:* 540/231-6878
• *Director's number:* 540/231-5923

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 or sexuality in a significant way.

How to Apply:
Fill out the online application for participation in the certificate program.

Women's & Gender Studies
WGSC

Address:
507 McBryde Hall (0137) Virginia Tech
Blacksburg, VA 24061-0137

Contact this Certificate

Email Contact(s):
• Director

Web Resource(s):
• Website

Phone Number(s):
• *Main Office:*
540/231-6878
• *Director's number:*
540/231-5923

Certificate Overview | Admissions & Course Requirements

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 and have at least one WGS faculty or affiliate faculty on the committee.

Additional Information

Please contact the WGS Director at spjohnson@vt.edu to discuss the Program, course options, and graduate student activities. Friend us on FaceBook at https://www.facebook.com/wgsatvt