GRADUATE CATALOG 2010-2011

Policies, Procedures, Academic Programs

GRADUATE SCHOOL POLICIES & PROCEDURES

Graduate School Policies and Procedures

Introduction

This document sets forth policies, procedures and requirements relating to graduate study at Virginia Polytechnic Institute and State University (Virginia Tech). The policies in this document have been developed by the Commission on Graduate Studies and Policies (CGS&P) and approved by the faculty governance system of Virginia Tech. This document is designed to assist all those involved in graduate education at the university. The major responsibility for knowing and completing the degree requirements rests with the graduate student. The Advisor (i.e., the Chair of the student's Advisory Committee or Major Professor) and the student´s Advisory Committee help the student prepare a Plan of Study (that lists the course work required for the degree) and select an appropriate research topic. The Graduate School seeks to foster quality in all phases of graduate education.

Graduate Student Responsibilities

It is the student's responsibility to satisfy all university requirements described in the Graduate School Policies and Procedures section in the Graduate Catalog http://www.grads.vt.edu/academics/gcat/index.html as well as any additional requirements established by the faculty in the academic program in which the student is enrolled. Policy changes that occur between revisions of the catalog are described in the Graduate School Blog https://secure.grads.vt.edu/weblog/monthlymemo/ In addition to the procedures included in this document, procedural information is available at http://www.grads.vt.edu/academics/procedural_guidelines/index.html

Graduate Student Ombudsperson

The Graduate Student Ombudsperson, with an office in the Graduate Life Center, provides confidential help to graduate students to resolve issues and address concerns that arise within the university setting. The ombudsperson provides a resource for and information about institutional policies and acts as a facilitator to work toward resolutions of graduate students' concerns. The office is an informal avenue for graduate students, and consultations are kept confidential, unless the student grants permission for the ombudsperson to discuss issues with involved parties or administrators.

Graduate Honor System

Compliance with the Graduate Honor Code requires that all graduate students exercise honesty and ethical behavior in all their academic pursuits at Virginia Tech, whether the undertakings pertain to study, course work, research, engagement, or teaching. The Constitution of the Graduate Honor System is contained http://ghs.grads.vt.edu

Graduate Program Responsibilities

Each graduate program/department that offers graduate degrees or certificates lists the requirements of those degrees or certificates in the Graduate Catalog and in their departmental Graduate Policies document which is available on the departmental website. The Graduate School website provides links to these Degrees and Programs http://www.grads.vt.edu/academics/programs/index.html Each graduate program should identify a graduate program faculty who have the ultimate responsibility for quality of the graduate program in the academic unit. A member of the graduate program faculty will serves as the Graduate Program Director for overseeing academic matters in the graduate program and who chairs the departmental Graduate Program Committee. The Department Head//Chair/Director may appoint the Graduate Program Director as the signing authority for all departmental graduate transactions. In some departments, the Department Head serves as the Graduate Program Director. Most programs also have a staff member designated as the Graduate Coordinator who is involved with overseeing many technical aspects of the graduate program. Each department is responsible for developing procedures for Advisory Committees to use in the Annual Evaluation of Progress of each graduate student in the program. These evaluations should consider GPA, courses with grades of Incomplete or other grade problems, progress on the Plan of Study, preliminary exam performance (doctoral students), research performance, teaching performance, assistantship status and performance, general departmental citizenship, and recommendations for the next review period. For those students who have not yet established an Advisory Committee, the evaluation should be conducted by a departmental committee, the Graduate Program Director, or the Department Head. The results of the evaluation, including a Rating indicating whether the student's progress is Satisfactory or Unsatisfactory, should be placed permanently in the student's file in the department and the student should be informed of the results of the annual evaluation. In cases of Unsatisfactory ratings, it is especially important that written, constructive feedback about what the student needs to do to obtain a Satisfactory rating, be included in the evaluation. A summary of these annual evaluations for all students in the program, as well as the copies of the individual student evaluations, should be sent to the Graduate School by the end of spring semester each year (submission of electronic files are encouraged). This review process is mandated by Presidential Policy Memorandum #229 (2003) which is an update to #1 (1977). Periodic reviews of Graduate Programs and their standards and policies also are required. All programs in the university will be reviewed over a seven year cycle currently in progress. See Presidential Policy Memoranda #14 (1979), #126 (1992), and #152 (1995).

Changes

The university reserves the right to make changes in fees, policies, degree requirements, schedules, or courses offered.

Exceptions to Policy

Exceptions to policies may be requested of the Dean's Office of the Graduate School. A request for an exception should cite the policy, justify the request, and demonstrate appropriate departmental support for the request. Requests for exceptions should come from the graduate student's Advisor and have the support of the Graduate Program Director or Department Head.

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.judicial.vt.edu/upsl.php 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 www.studentmedical.vt.edu 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://www.grads.vt.edu/igss/maintaining_status/. 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 may travel overseas either on business or pleasure. 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 passports multilingual language services in emergency situations coordination centers and phone numbers throughout the world MEDEX is already a part of the Virginia Tech medical insurance offered to full-time students attending the university. For further information on MEDEX services or the student medical insurance program, contact Risk Management by telephone 540/231-7439, fax 540/231-5064, or e-mail to weaverf@vt.edu
http://www.controller.vt.edu/risk/

Automobiles

Motor vehicles owned and operated by students who drive them on campus must be registered with the University Parking Services Office when the vehicle is brought on campus. Parking and operating regulations are issued at the time of registrationhttp://www.facilities.vt.edu/ot/parking.asp

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: http://www.grads.vt.edu/academics/programs/index.html. 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://www.applyweb.com/apply/vtechg/index.html. If this is not possible, a printable application also is available.

Credentials

Official transcripts should be sent to both the Virginia Tech Graduate School and the academic department. 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. 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. All reference letters should be sent directly to the academic department. 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: http://www.grads.vt.edu/forms/international/immgrinfo_finreq_affidavitofsupport.pdf. 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). The results of the Test of English as a Foreign Language (TOEFL) are the most readily accepted demonstration of English proficiency for international applicants. A minimum TOEFL score of 550 paper-based (PBT), 213 computer-based (CBT) 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. Some departments have higher

TOEFL score requirements than those set by the Graduate School. For more details, see http://www.grads.vt.edu/igss/faculty_staff/toefl_interp.html English Placement Test (EPT) All incoming international graduate students are required to take the EPT, a diagnostic writing test, during the orientation period prior to the beginning of classes unless they have both a TOEFL score of 620 PBT, 260 CBT and an essay writing score (Test of Written English) of 4.5 or higher (out of 6) or higher. On the Internet-Based TOEFL (iBT) a total score of 105 with a writing subscore of 26 or higher (out of 30) is required for exemption from taking the EPT. Those who do not achieve the required scores on the EPT are required to take and satisfactorily complete a semester-long Advanced Academic Writing or Technical Writing course during the first semester of their enrollment at Virginia Tech along with their full load of academic classes (9-18 credit hours). There is an additional instructional fee for this course (fee includes the textbooks), taught by the Virginia Tech Language and Culture Institute (LCI; formerly called the English Language Institute; http://www.lci.vt.edu/elp/). National Capital Region (NCR) students should consult with the LCI office in that location about alternative sites for any required additional English training. Those at other sites should consult with the Graduate School offices in Blacksburg. SPEAK Test for International Graduate Teaching Assistants (GTAs) International GTAs who are assigned classroom or laboratory teaching duties must pass the SPEAK Test before they can begin their teaching duties. For international GTAs to be exempt from oral testing, a minimum Speaking score of 26 on the iBT is required. Those who do not pass the SPEAK Test must take English 0014, Oral Communication for International Teaching Assistants (1 Cr.) during the semester prior to beginning their teaching assignment. The SPEAK Test is administered individually during the Orientation Period. All GTAs also must attend and be enrolled in the GTA Workshop which begins on the Monday of the week before fall semester classes start in August (see Academic Eligibility to Hold a Graduate Assistantship). 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, gsso@nvc.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, gsso@nvc.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. After attempting 12 graduate credits and earning at least a 3.00 GPA, a student is changed to Regular status by the Graduate School. 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 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://www.grads.vt.edu/forms/academics/certificate_application.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. 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.

Professional Certification Status

(Departments of Teaching and Learning and Educational Leadership and Policy Studies only) Admission requirements for Professional Certification include a bachelor's degree from an accredited university plus appropriate professional experience. Under this admissions category, a maximum of 12 credit hours of courses may be taken on a pass/fail basis only, and the courses taken may not be used toward a graduate degree. This is a restricted admission that permits students to enter only certain approved courses in these departments. Individual instructors may reject from their courses anyone in this category who does not meet the normal prerequisites.

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://grads.vt.edu/forms/academics/Application_for_Visiting_Graduate_Student.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. Also see the section on Teaching Assignments for Graduate Students below.

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 Concurrent Undergraduate and Graduate Status Form (for obtaining Dual Status). 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 one of the two-year master's programs in urban and regional planning or 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 new CGS&P policy effective for Fall 2010 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 number of courses to double counted). These regulations include the following: Students must be accepted into the program prior to the beginning of the semester in which they would enroll in courses to be used on the accelerated program. Students qualifying for the program must be in the last 12 months of their undergraduate degree A 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) you wish to offer 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 résumé, 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/. Students may adjust their schedules 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 carry out an electronic change, 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. http://www.grads.vt.edu/forms/academics/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 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://www.registrar.vt.edu/forms/documents/resign_withdrawal.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 http://www.bursar.vt.edu/refunds/refund_policy.php). 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 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 an approved leave of absence, graduate students in degree programs must be registered continuously during the academic year (fall and spring semesters) and pay the prescribed tuition and fees. 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 except in the case of a student who qualifies for Defending Student Status. 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).

Registration at the Time of Examinations and for Degree Completion

Graduate students must be registered 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 Defending Student Status (DSS, 1 credit; see Defending Student Status under Examinations and see Dates for Degree Completion at http://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html). Students are not required to be enrolled for the purpose of certificate completion alone.

Leave of Absence

Students sometimes experience situations in which they cannot be continuously enrolled. A student may request a Leave of Absence to suspend activities associated with course work or thesis/dissertation research. The Request for Leave of Absence form http://www.grads.vt.edu/forms/academics/Leave_of_Absence_Request.pdf 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 a graduate Dean approves the leave, the continuous enrollment requirement will be relaxed during the period of leave. The Leave of Absence form indicates the time 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. International students should consult the immigration advisors in the Graduate School before taking a leave of absence.

Readmission

When a student has not been registered for more than one calendar year, an Application for Readmission http://www.grads.vt.edu/forms/academics/Application 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://www.grads.vt.edu/forms/index.html

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://www.grads.vt.edu/forms/academics/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://www.grads.vt.edu/forms/academics/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 (apply on-line at http://www.grads.vt.edu).

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://www.grads.vt.edu/forms/academics/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://www.grads.vt.edu/forms/academics/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://www.grads.vt.edu/forms/academics/Application_for_Simultaneous_Degree.pdf See also Credit Hour Requirements; Simultaneous Degrees.

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 or 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 "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. An Audit is a mechanism for a student to reserve a seat in a course, with no performance evaluation of the student. 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 restrict the participation of auditing students in selected activities, then that should be stated in the syllabus. 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 Plan of Study about the limited use of undergraduate courses on Plans of Study). Instructors should not allow students to attend if they aren't 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) done 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/tuition/.

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.grads.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. Courses double counted for both degrees for Accelerated Undergraduate/Graduate Degree Program students are transferred from the bachelor's degree onto the master's Plan of Study, so the rules for Transfer courses apply.

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/forms/academics/Course_Justification_Request.pdf and some procedural guidelines are at http://www.grads.vt.edu/academics/procedural_guidelines/index.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://www.grads.vt.edu/forms/academics/Chg_Plan.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. Such changes often require changes in the Plan of Study and coursework required. These changes require approval of the Department Head/Graduate Program Director and the Chair of the student's Advisory Committee.
http://www.grads.vt.edu/forms/academics/thesis_option_change.pdf

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 (see below).

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 or 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. 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 (i.e., Chairs of Advisory Committees) must be teaching/research faculty (i.e., full time, tenured or tenure track faculty at Virginia Tech), i.e., Graduate Program Faculty, in the graduate program in which the student is enrolled. A department may request that qualified non-tenure track faculty (e.g., Research Professors or Emeritus faculty who are research active) be approved as members of the Graduate Program Faculty of a department for purposes of having Chair/Co-chair privileges. 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). 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 are not permitted to serve as Advisor or committee member for individuals with whom they have a personal or professional relationship (e.g., spouse/partner, son/daughter, business associate, employment supervisor, etc.). 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, teaching/research faculty, may be recommended for inclusion on a graduate student Advisory and/or Examining Committee, but may not serve as Advisory Committee Chairs. The form requesting that such personnel serve on graduate committees is at http://www.grads.vt.edu/forms/academics/Grad_Progr_Fac_Addl_Members.doc 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. Inclusion of committee members in these categories is requested by the student’s Advisory Committee Chair and Graduate Program Director using the form for Non-Virginia Tech Program Faculty Committee Member Registration. A curriculum vita 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. 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. Changes in a Student’s Advisory Committee Changes in a Student’s Advisory Committee: will be granted only on approval of all committee members, new and old, and on recommendation by the Department Head or Graduate Program Director http://www.grads.vt.edu/forms/academics/Chg_Committee.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.

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 bachelors 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 6 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. 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://www.grads.vt.edu/forms/academics/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.

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). See Transfer Credit for policies about the transfer of graduate credits for use on the Plan of Study. Courses transferred from the bachelor's to the master's degree for a student in the Bachelor/Master's program at Virginia Tech cannot be used for doctoral credit (i.e. they cannot be 'triple counted'). Minimum total credits: 90 credit hours Minimum graded credits: 27 credit hours At least 27 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. 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. 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.

Certificate of Advanced Graduate Study (CAGS)

The Center for Public Administration and Policy CAGS program affords the student the opportunity to develop an advanced level of post-master's specialization in a public policy field (e.g., energy, human resources, or environmental policies) or a public management field (e.g., finance or personnel). This program recognizes the successful completion of 60 hours of doctoral level work, including the Qualifying Examination. Students with master's degrees who can profit from doctoral course work but do not need or wish to write the dissertation are invited to apply. Students accepted into the CAGS program may apply later to proceed toward the Ph.D.

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. The specific requirements for each certificate can be found on the Graduate School Home Page at: http://www.grads.vt.edu/academics/programs/certificates.html. Certificate candidates must be admitted to the Graduate School and formally accepted to the certificate program http://grads.vt.edu/forms/academics/Application%20-%20Certificate.pdf Upon successful completion of certificate requirements, an Application For Certificate Conferral http://grads.vt.edu/forms/academics/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://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html Enrollment is not required for certificate completion alone.

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. http://grads.vt.edu/forms/academics/Request_to_Admit_Candidate_to_Final_Exam.pdf http://grads.vt.edu/forms/academics/Request_to_Admit_Candidate_to_Prelim_Exam.pdf 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 and the examination form/card 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 and the examination form/card has been received. The signed examination form should be returned to the Graduate School within 1-2 days after the examination with each committee member signifying whether the exam performance was Satisfactory or Unsatisfactory. 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 a 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. 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 Advisory Committee members are required to participate in doctoral examinations, at least three are required for a Master's examination. If one of the Advisory Committee members cannot be present at an exam, the Chair of the Advisory Committee should request, in a brief letter accompanying the exam request, that another faculty member serve on the Examining Committee. Those conducting the examination must all sign the examination form and indicate whether they consider the student's performance to be Satisfactory or Unsatisfactory. Examination form should be returned to the Graduate School within 1-2 days after the exam. Note that a substitute member who serves on a final examination committee does not sign the Thesis or Dissertation Approval Form, it remains the responsibility of the student's Advisory Committee to evaluate the thesis or dissertation and sign this form.

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 is required of all master's programs (see departmental policy for specific format). For some non-thesis master's programs, final exams are structured in special ways and in some non-thesis master's degrees the evaluation of a project is used in lieu of a final examination. For more information about master's final examinations, consult the departmental policies and procedures document.
http://grads.vt.edu/forms/academics/Request_to_Admit_Candidate_to_Final_Exam.pdf

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 six (6) months before the Final Examination. The Preliminary Examination may be oral or written, or both
http://grads.vt.edu/forms/academics/Request_to_Admit_Candidate_to_Prelim_Exam.pdf. 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. In such cases, the examination date requested should coincide with the date when the decision about the student's performance is made. The results should be reported to the Graduate School within 1-2 days of the decision about the examination. If a department conducts the Preliminary Examination as a departmental examination, the members of the individual student's Advisory Committee must sign the examination form/card. 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.

Final Examination (Doctoral)

All doctoral candidates must take a final oral and/or written examination, which is at minimum a defense of the dissertation. This examination must be scheduled no earlier than six months after successful completion of the preliminary examination.
http://grads.vt.edu/forms/academics/Request_to_Admit_Candidate_to_Final_Exam.pdf 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 semesterhttp://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html

Registration/enrollment at the Time of Examinations

Graduate students must be enrolled for the minimum number of credits 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. Students Working on the Thesis/Dissertation during a Semester or Summer The minimum enrollment for students working on writing their thesis/dissertation and consulting with their Advisor and/or committee during a semester or summer is 3 credit hours. The exception is those students who may qualify for Defending Student Status (see below). Defending Student Status Qualification for DSS: A student who is • on active status (i.e., does not require Readmission) and • has a thesis/dissertation ready for defense at the beginning of the semester may qualify for Defending Student status (DSS, 1 credit). To be ready to defend, the student's Advisory Committee members must have read the thesis/dissertation and agreed that it is in a form ready for defense (i.e., the thesis/dissertation is finished) and that it appears that the student will be able to make corrections and file the thesis/dissertation as an ETD by the deadline of two weeks after the defense. If a student is not on active status, i.e., has not been enrolled for more than a calendar year, the Readmission process must be completed before the student can file to take the Final Examination or qualify for DSS. The "DSS scheduling period" is • the first three weeks of an academic semester and • the Request for Final Exam must be received by the Graduate School within this scheduling period. To allow for time to process the exam request (two weeks), students should make every effort to submit the DSS form and the Request to Schedule Examination form to the Graduate School by the end of the second week of the semester. Final Exam/defense Date: If the student qualifies for DSS: • the exam date should be set for as early as possible in the semester • if the exam needs to be delayed, the student's Advisor should explain the circumstances for the delay (e.g. employment at a distance that does not allow travel at certain times, committee members who are away on international travel, etc), in a letter/email to the Dean's office. • students are urged to pay careful attention to timing deadlines relative to Commencement. See http://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html for the deadlines for each semester of the current year. DSS Enrollment: If DSS is approved, the Graduate School will register the student for 1 credit of GRAD 6864 (Master's Defense) or GRAD 7864 (Doctoral Defense). Students cannot enroll themselves in DSS. If the student does not qualify for DSS, the minimum enrollment of 3 credits is required. Students enrolled in DSS will be classified as less than half-time for certification purposes. • This status may not meet the minimum requirement for most student financial aid or loan deferments. • Students may wish to take into consideration their student loans when applying for DSS status. • International students should consult the Graduate School concerning the visa implications of this status. • Students on DSS are not eligible to hold assistantships or fellowships (see the section on Eligibility for Graduate Assistantships).

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://grads.vt.edu/forms/academics/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.

Advisory Committee Approval of the Thesis or Dissertation

The thesis/dissertation must be evaluated by all members of a student's Advisory Committee. Committee members signify approval or disapproval by signing the Thesis/Dissertation Approval form. This signifies that the thesis or dissertation is in final form and ready for ETD submission to the Graduate School. This form is available at http://www.grads.vt.edu/forms/academics/ETD/Thesis_Dissertation_Approval_Form.pdf. 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.

Electronic Thesis and Dissertation (ETD)

Theses and dissertations are submitted electronically. For instructions, see http://www.grads.vt.edu/academics/completion/etd.html

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 the 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 DSS in the later semester when degree completion occurs. http://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html

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://www.copyright.gov/register/

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://grads.vt.edu/forms/academics/Application_for_Degree_or_Certificate.pdf or an Application For Certificate Conferral http://grads.vt.edu/forms/academics/Application_for_Degree_or_Certificate.pdf to obtain a diploma or certificate and to have their names appear in the Commencement Bulletin 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://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html

Graduation Clearance Procedures

Summary of Procedures Summary of Procedures for a candidate for the master's or doctorate degree: 1. 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. 2. Taking Final Examination 3. Filing of Application for Degree, payment of fee. This form makes an individual degree completion checklist available to the student on Hokie SPA http://www.grads.vt.edu/academics/dates_deadlines/completion_checklist_masters.pdf http://www.grads.vt.edu/academics/dates_deadlines/completion_checklist_doctoral.pdf 4. Submitting the final version of the thesis or dissertation, approved by the student's Advisory Committee as an Electronic Dissertation or Thesis (ETD) within two weeks after the defense 5. Submitting the completed and signed Thesis/Dissertation Approval form http://www.grads.vt.edu/forms/academics/ETD/etd_approval.pdf at the time of ETD submission 6. Submitting any applicable supporting documentation for the ETD, i.e.: 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://www.grads.vt.edu/academics/dates_deadlines/commencement_deadlines.html

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

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 http://www.grads.vt.edu/academics/programs/index.html 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.

ACCOUNTING AND INFORMATION SYSTEMS

Reza Barkhi, Head

Professors: France Belanger; Robert Brown; C Cloyd; James Hicks; James Jenkins; Larry Killough; John Maher; Wilmer Seago;

Associate Professors: Reza Barkhi; Sudip Bhattacharjee; John Brozovsky; Weiguo Fan; Samuel Hicks; Debra Salbador; Steven Sheetz; David Tegarden; Linda Wallace; James Yardley;

Assistant Professors: Mitchell Oler; Velina Popova;

R. B. Pamplin Professor: Robert Brown; Wilmer Seago;

John E. Peterson, Jr. Professor: C Cloyd;

KPMG Professor: Larry Killough;

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

General Contact: acis@vt.edu

Graduate Contact: arnita@vt.edu

Graduate Site: www.grads.vt.edu

Department Site: http://www.acis.pamplin.vt.edu

The accounting and information systems department offers programs of graduate study leading to degrees of master of accounting and information systems and Ph.D. in business with a major in accounting and information systems.

SPECIAL FACILITIES

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (650.0)

Computer: (280.0)

iBT: (115.0)

GMAT

: Total (640.0)

Ph.D. ProgramRequirements: Minimum GPA: 3.2; Minimum TOEFL: 650/280/115; Minimum GMAT Score: 640The program leading to the Ph.D. in business with a major in accounting and information systems permits the student to pursue advanced graduate studies in preparation for a career in college and university teaching and research.The first two or three years of the Ph.D. program are devoted to course work. The program's basic requirements include core course work in accounting and 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.

MACIS Degree

Offered In (Blacksburg)

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GMAT

: Total (520.0)

Master of Accounting and Information Systems ProgramThe master of accounting and information systems program provides graduate-level education for professional careers in accounting and information systems. For those planning to enter a Ph.D. program, the program offers the necessary foundation.The program is open to students with a bachelor's degree in any discipline. Students without prior collegiate studies in accounting, information systems, and/or business administration can expect to spend additional time in the program completing prerequisites. For those who have fulfilled the background requirements, the program consists of 30 semester hours and can normally be completed in 12 to 17 months.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 any grade less than C, will result in automatic expulsion from the program, absent extenuating circumstances approved by the student's course advisor and the department head.All masters of accounting and information systems students take the following two courses:ACIS 5214 Advanced Strategic Cost ManagementACIS 5514 Management of Information SystemsThe additional eight courses depend on the student's choice of one of four possible career options: Audit, Tax, Financial Services, or Information Systems. Additional courses for these options are as follows:Audit:ACIS 4554 Networks and Telecommunications in BusinessACIS 5014 Information Systems Audit and ControlACIS 5324 Taxation of Business EntitiesACIS 5414 Auditing TheoryACIS 5584 Information Systems Security and AssuranceFIN 5194 Commercial LawPlus two of the following four courses:ACIS 5034 Global Issues in Accounting and Information SystemsACIS 5124 Governmental and Nonprofit AccountingACIS 5134 Mergers and AcquisitionsACIS 5194 Financial Statement AnalysisTax:ACIS 5314 Tax Concepts and ResearchACIS 5324 Taxation of Business EntitiesACIS 5334 Advanced Corporate TaxACIS 5364 Multi-jurisdictional Tax ConceptsACIS 5414 Auditing TheoryFIN 5194 Commercial LawACIS 5014 Information Systems Audit and Control OR ACIS 5034 Global Issues in Accounting and Information SystemsACIS 5124 Governmental and Nonprofit Accounting OR ACIS 5134 Mergers and AcquisitionsFinancial Services:ACIS 5194 Financial Statement AnalysisACIS 5324 Taxation of Business EntitiesACIS 5414 Auditing TheoryFIN 5044 Asset ValuationFIN 5054 Options and FuturesFIN 5064 Equity MarketsFIN 5074 Interest RatesFIN 5194 Commercial LawACIS 5014 Information Systems Audit and Control OR ACIS 5034 Global Issues in Accounting and Information SystemsACIS 5124 Governmental and Nonprofit Accounting OR ACIS 5134 Mergers and AcquisitionsPlus one of the following three courses:FIN 5204 Managing Corporate Capital Investment and Capital StructureFIN 5244 Managing Corporate Risk with DerivativesFIN 5264 Mergers and Acquisitions and Corporate RestructuringInformation Systems:ACIS 5014 Information Systems Audit and ControlACIS 5034 Global Issues in Accounting and Information SystemsACIS 5524 Advanced Database Management SystemsACIS 5534 Information Systems DevelopmentACIS 5554 Applied Software DevelopmentACIS 5584 Information Systems Security and AssuranceACIS 5594 Web-Based Applications and Electronic CommerceElective (advance approval of advisor required)

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ACIS 5024:

Seminar In Accountability

Introduction to concepts, applications and issues related to the subject of "accountability"; primarily from the perspectives of accounting and business, while branching into other disciplines for comparisons; history and evolution; development of a general model to explain the relationships, responsibilities and behavior of parties involved; application of the model to a variety of settings to test its validity and to gain insights into successes and failures of accountability relationships.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ACIS 5034:

Global Issues in Accounting and Information Systems

Accounting and information systems issues with emerging economies and the global business environment. Graduate standing and business core required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ACIS 5114:

Advanced Accounting

In-depth analysis of business mergers and acquisitions, consolidated financial statements, translation and remeasurement of foreign currencies, partnership accounting, financial distress, and other selected complex financial accounting and reporting topics. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ACIS 5554:

Applied Software Development Project

Application of system analysis, design, and implementation concepts, principles, and practices to a comprehensive system development project. A team approach is used to analyze, design, implement, and document realistic systems of moderate complexity. Use of project management methods, project scheduling and control techniques, formal presentations, walk throughs, and group dynamics in the solution of information systems problems. Development of a database to support the system.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ACIS 5574:

Design Strategies for e-Business Systems

This course focuses on the strategic business analysis and design requirements of an e-Business System. This course focuses on the design of the marketing, knowledge, and transaction processing components of a typical e-business system. The course develops skills required in doing requirements analysis for e-businesses, understanding business processes required for e-businesses, and designing effective e-business architectures. Emphasis is placed on the application of object-oriented systems design, suitable analysis and design concepts from structured analysis, business process reengineering, and design of web-enabled client-server systems. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ACIS 5584:

Information Systems Security and 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

ACIS 5594 (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 and the prerequisites to the Master of Accountancy program.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

ACIS 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ACIS 5954:
Study Abroad
Credit Hour(s): 1 TO 6
Lecture Hour(s): 1 TO 6
Instruction Type(s): Lecture

ACIS 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

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

ACIS 5994:
Research And Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

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 philosphy of science, the nature of theory, researchy 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

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

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

ACIS 6504:
Seminar in Information Systems Research
A research seminar that focuses on contemporary topics in information systems. The course can be focused on a specific area of interest such as the philosophical foundations of information systems, cognitive issues in information systems, behavioral issues in information systems, group support systems, information systems project management, knowledge management, information visualization, or information systems development, or can be focused on a set of separate topics. Pre: permission of instructor II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ACIS 7994:
Research And Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

AEROSPACE ENGINEERING

Robert Canfield, Head

Professors: Alan Brown; Robert Canfield; William Devenport; Christopher Hall; Rakesh Kapania; Joseph Schetz; Roger Simpson;
Associate Professors: Wayne Neu; Christopher Roy; Craig Woolsey;
Assistant Professors: Mazen Farhood; Leigh McCue-Weil; Mayuresh Patil; Michael Philen; Gary Seidel; Cornel Sultan;
NAVSEA Professor of Naval Ship Design: Alan Brown;
Norris & Laura Mitchell Professor of Aerospace Engineering: Rakesh Kapania;
Fred D. Durham Endowed Chair: Joseph Schetz;
Jack E. Cowling Professor: Roger Simpson;

Graduate Contact: aoegradcoordinator@vt.edu
Student Handbook: http://www.aoe.vt.edu/graduate/forms/grad-policies-procedures-09-30-10.pdf
Graduate Site: http://www.aoe.vt.edu/graduate/index.html

Masters of Science Degree OverviewThe 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 multidiciplinary 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 OverviewThe 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 OverviewThe 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 multidiciplinary 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

Two space dynamics-related laboratories exist at Virginia Tech. The Space Systems Simulation Laboratory includes two spherical air bearings with approximately 150kg payload each, and allows experimental verification of algorithms and control laws involved in the large-angle, three-dimensional motion of rigid and flexible bodies using internal and external torques, along with distributed control and inter-satellite communications. The Satellite Tracking Laboratory is an education-focused lab, and includes computers and an amateur satellite ground station. Students in space-related courses can perform a variety of experiments involving actual satellites, aimed at strengthening their understanding of space dynamics, state estimation, motion prediction, and space physics, and the effects these principles have on the design and operation of spacecraft. The 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. Founded by Dr. Craig Woolsey and Dr. Naira Hovakimyan in 2005, the NSL is now co-directed by Dr. Woolsey and Dr. Cornel Sultan. The NSL is a Core Laboratory in the Virginia Center for Autonomous Systems (VaCAS).The Structures Lab 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 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 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.This facility includes a unique moving end-wall system, consisting of a belt that moves beneath the blade tips to simulate the relative motion between blades and casing found in a real turbomachine. The layout of the moving endwall system is shown above. The moving wall is a continuous flat belt driven by rollers at speeds of up to 25m/s. The belt is made from 0.01"-thick Mylar film. The width of the belt is 27". The total length of the belt is about 25' . The belt is driven by a 8" diameter high precision flat-surface roller. Another 8" diameter crowned surface roller is used to adjust and keep the position of the belt. The driving rollor is powered by a 15-horse power AC motor. A digital motor controller is used to control the rotating speed of the motor by changing the output frequency. The belt is supported by a flat Teflon coated bed. Several slots cut into the bed provide suction to hold the belt on the bed, restricting its vertical vibration to a few microns. 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.

The Low Speed Compressor 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. This facility includes a unique moving end-wall system, consisting of a belt that moves beneath the blade tips to simulate the relative motion between blades and casing found in a real turbomachine. The layout of the moving endwall system is shown above. The moving wall is a continuous flat belt driven by rollers at speeds of up to 25m/s. The belt is made from 0.01"-thick Mylar film. The width of the belt is 27". The total length of the belt is about 25' . The belt is driven by a 8" diameter high precision flat-surface roller. Another 8" diameter crowned surface roller is used to adjust and keep the position of the belt. The driving rollor is powered by a 15-horse power AC motor. A digital motor controller is used to control the rotating speed of the motor by changing the output frequency. The belt is supported by a flat Teflon coated bed. Several slots cut into the bed provide suction to hold the belt on the bed, restricting its vertical vibration to a few microns.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.

The Nonlinear Sytems Laboratory (NSL)

The 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. Founded by Dr. Craig Woolsey and Dr. Naira Hovakimyan in 2005, the NSL is now co-directed by Dr. Woolsey and Dr. Cornel Sultan. The NSL is a Core Laboratory in the Virginia Center for Autonomous Systems (VaCAS).

The 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 Structures Lab

The Structures Lab 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.

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, of which up to 10 (0 for non-thesis) credit hours may be allotted for research and thesis (AOE 5994) credit. (Non-thesis students may use up to 10 credit hours of AOE 5904: Project and Report if they will complete their M.S. requirements with a project and report). 2. A minimum of 12 (15 for non-thesis) credit hours (excluding thesis, AOE 5994) of course work numbered 5000 and higher must be included in the Plan of Study. This does not include the AOE Seminar. 3. A maximum of 6 (9 for non-thesis) credit hours of Independent Study (5974) and Special Study (5984) is allowed. 4. A maximum of 6 credit hours of 4000 level courses approved for graduate credit is allowed. 5. Up to 50% of the courses on the Plan of Study may be transferred, subject to approval of the Advisory Committee. 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 5104, Advanced Aero and Hydrodynamics; AOE 5024, Vehicle Structures; AOE 5204, Vehicle Dynamics and Control; and AOE 4404, Applied Numerical Methods. The following additional required courses pertain to the three areas of specialization. Aero-Hydrodynamics: 9 (18 for non-thesis) credit hours of approved electives. Non-thesis students must take two of the following courses: AOE 5114, High Speed Aerodynamics; AOE 5135, Vehicle Propulsion; or AOE 5144, Boundary Layer Theory and Heat Transfer. Dynamics and Control: 9 (18 for non-thesis) credit hours of approved electives. Non-thesis students must take two of the following courses: AOE 5774, Nonlinear Systems Theory; AOE 6744, Linear Control Theory; or AOE 5234, Orbital Mechanics. Structures and Structural Dynamics: 9 (18 for non-thesis) credit hours of approved electives. Non-thesis students must take: AOE 5034, Vehicle Structural Dynamics; and MATH 4574, Vector and Complex Analysis for Engineers. 7. If a student has previously taken, while a Virginia Tech 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. Any required AOE course may be replaced only with another AOE course. 8. Courses in which a student is deficient upon entering the program must be made up in a manner which satisfies the Advisory Committee. 9. All course work that appears on the Plan of Study must have been taken within the five years previous to time of submission of the Plan, or must be completed within five years after the time of submission of the plan. Any course which exceeds these limits must be validated by examination. Master of Science or Master of Engineering Requirements (AOE, Systems Option): The AOE Department, in conjunction with the Systems Engineering Technical Interest Group, 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 is prescribed by the Systems Engineering Advisory Board.

MEng Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

Master of Engineering Requirements: 1. The Master of Engineering 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). 2. A minimum of 30 credit hours is required, of which 3-6 credit hours must be allotted for AOE 5904: Project and Report. 3. A minimum of 15 credit hours (including 5974 and 5984) of 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 courses is allowed. 5. A maximum of 9 credit hours of Independent Study (5974) and Special Study (5984) is allowed. 6. Up to 50% of the courses on the Plan of Study may be transferred and are subject to approval of the Advisory Committee. Each transferred course must have a grade of B (3.0/4.0) or better. 7. A minimum of one approved Mathematics course is required. 8. All M. Engr. candidates are required to take: AOE 4404, Applied Numerical Methods; AOE 5104, Advanced Aero-Hydrodynamics; AOE 5024, Vehicle Structures I; AOE 5204, Vehicle Dynamics and Control; and One additional AOE course. 9. 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. 10. Courses in which a student is deficient upon entering the program must be made up in a manner which satisfies the Advisory Committee. 11. All course work that appears on the Plan of Study must have been taken within the five years previous to time of submission of the Plan, or must be completed within five years after the time of submission of the plan. Any course which exceeds these limits must be validated by examination. 12. 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 the Systems Engineering Technical Interest Group, 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 is prescribed by the Systems Engineering Advisory Board.

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 courses 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 Seminar. 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 research 7994) must be earned while in residence. 7. Transfer credit hours may not exceed 50% of course work on the Plan of Study and are subject to the approval of the Advisory Committee. 8. The following additional courses are required according to the area of specialization: Aero-Hydrodynamics Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; AOE 5104, Advanced Aero and Hydrodynamics; AOE 5024, Vehicle Structures; AOE 5204, Vehicle Dynamics and Control; AOE 5114, High Speed Aerodynamics; AOE 5135, Vehicle Propulsion; and AOE 5144, Boundary Layer and Heat Transfer. Before taking the Final Examination: AOE 5454, Advanced Aerospace and Ocean Engineering Instrumentation; and AOE 6114, Transonic Aerodynamics. Plus any one of the following before taking the Final Examination: AOE 5984, Introduction to Computational Fluid Dynamics; AOE 6145, Computational Fluid Dynamics; or AOE 6434, Computational Fluid Dynamics and Heat Transfer. Plus any two of the following before taking the Final Examination: AOE 6124, Hypersonic Aerodynamics; AOE 6154, Turbulent Shear Flow; AOE 6164, Unsteady Fluid Dynamics; AOE 5984, Verification and Validation in Scientific Computing; or AOE 5984, Rarefied Gas Dynamics. Dynamics and Control Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; AOE 5104, Advanced Aero and Hydrodynamics; AOE 5024, Vehicle Structures; AOE 5204, Vehicle Dynamics and Control; AOE 5774, Nonlinear Systems Theory; and AOE 6744, Linear Control Theory. Before taking the Final Examination: Courses determined in consultation with the Advisory Committee. Ocean Engineering Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; AOE 5104, Advanced Aero and Hydrodynamics; AOE 5074, Advanced Ship Structural Analysis*; and AOE 5334; Advanced Ship Dynamics. Plus any two of the following before taking the Preliminary Written Examination: AOE 5144, Boundary Layer and Heat Transfer; AOE 4024, An Introduction to the Finite Element Method; ESM 5734, Introduction to Finite Elements; AOE 5034, Vehicle Structural Dynamics; ESM 5314, Intermediate Dynamics; ECE 5704, Linear Systems Theory; MATH 5425, Applied Partial Differential Equations; or MATH 5474, Finite Difference Methods. *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 or AOE 5374: Rationally-Based Design of Ocean Structures. Two of the following courses before taking the Final Examination: Courses listed above and not taken prior to the Preliminary Written Examination; AOE 5044, Dynamic Stability of Structures; AOE 5374, Rationally-Based Design of Ocean Structures; AOE 5454, Advanced AOE Instrumentation; AOE 6145, Computational Fluid Mechanics; AOE 6XXX, Ship Vulnerability to Underwater Explosion; AOE 5064, Structural Optimization; ME 6624, Advanced FE Application in Mechanical Design; or ESM 6314, Advanced Dynamics. Structures and Structural Dynamics Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; AOE 5104, Advanced Aero and Hydrodynamics; AOE 5024, Vehicle Structures; AOE 5204, Vehicle Dynamics and Control; AOE 4054, Stability of Structures; and AOE 5034, Vehicle Structural Dynamics. Two of the following courses before taking the Final Examination: AOE 5054, Elastic Stability; AOE 5064, Structural Optimization; AOE 5074, Computer-Aided Design of Vehicle Structures; or AOE 6024, Aeroelasticity. Applied Physics & Space Engineering Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods; and AOE 5504, Spacecraft/Environmental Interactions. Plus any one of the following before taking the Preliminary Written Examination: ECE 5105, Electromagnetic Waves; ECE 5106, Electromagnetic Waves; or PHYS 5405, Classical Electromagnetism. Before taking the Preliminary Written Examination: One graduate level course in Mathematics, as determined by Advisory Committee; One graduate level course in Physics, as determined by Advisory Committee; One graduate level course in AOE, as determined by Advisory Committee; and One additional graduate level course in AOE, ECE, or Physics, as determined by Advisory Committee. Before taking the Final Examination: AOE 4404, Applied Numerical Methods. Two of the following courses before taking the Final Examination: AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; or AOE 5204, Vehicle Dynamics and Control. Before taking the Final Examination: Courses determined in consultation with the Advisory Committee. Applied Mathematics Before taking the Preliminary Written Examination: AOE 4404, Applied Numerical Methods. Two of the following courses before taking the Preliminary Written Examination: AOE 5024, Vehicle Structures; AOE 5104, Advanced Aero and Hydrodynamics; or AOE 5204, Vehicle Dynamics and Control. Before taking the Preliminary Written Examination: § MATH 4525, Principles of Advanced Calculus I; § MATH 4526, Principles of Advanced Calculus II; and Two graduate level course in Mathematics, as determined by Advisory Committee. Before taking the Final Examination: Additional courses as determined by Advisory Committee.

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

AOE 5034 (ESM 5304) (HNFE 5694) (PHS 5044):

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

AOE 5044:

Dynamic Stability of Structures

Modern structural stability analysis; static and dynamic instability; conservative and nonconservative systems; multiple loads; and Liapunov stability analysis. Applications to columns, rotating shafts, pipes conveying fluid, and airplane panels. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AOE 5054 (CEE 5454) (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

AOE 5064 (ESM 5064):

Structural Optimization

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

AOE 5135 (ME 5135) (GIA 5116) (PSCI 5116):

Vehicle Propulsion

Aeothermodynamics 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

AOE 5136:

Vehicle Propulsion

Aeothermodynamics 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

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

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

AOE 5214:

Aircraft Dynamics and Control

General equations of aero/hydrodynamic vehicular motion including the effects of flexibility and changing mass. Consideration of buoyant, aerodynamic, gravitational and thrust forces, jet damping, thrust offset, and rotating machinery contributions. Reduction of equations to linearized form, aero/hydrodynamic stability derivatives. Stability and response characteristics. Application of classical control theory to aircraft control.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

AOE 5306:

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

AOE 5314:

Naval Ship System Design

Overview of the ship design process, and insight into the major factors which influence the technical trade-offs governing the synthesis of a ship design. The course is directed primarily at systems engineers, equipment engineers (hull, machinery and combat systems), and technical managers who interface with the ship design community. The course is also of value to practicing naval architects who desire a broad perspective into the ship integration process. (NAVSEA site only). Undergraduate engineering degree required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

AOE 5344:

Nonlinear Control of Mechanical Systems

Methods of nonlinear control, emphasizing techniques applicable to mechanical systems. Nonlinear system theory and stability analysis. Nonlinear controllability and observability. Input-output properties. Passive and dissipative systems and stability of interconnected systems. Common nonlinear control design techniques: feedback linearization; sliding mode control; adaptive control. Techniques for mechanical systems: potential shaping; kinetic shaping. Emphasis on applications to vehicle control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

AOE 5504:

Aerospace and Ocean Engineering

Introduction of the natural space environments: solar wind, planet atmosphere, ionosphere, magnetosphere, comets, and meteoroids. Introduction of the induced spacecraft environments. Advanced treatment of the physics and effects of atmospheric interactions, plasma interactions, radiation interactions, hypervelocity impacts, spacecraft contamination, and interactions induced by electric propulsion. Applications to spacecraft design. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

AOE 5754 (ME 5554) (ECE 5754):

Applied Linear Systems

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

AOE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AOE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

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

AOE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

AOE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

AOE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

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

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

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

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

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

AOE 6234:
Spacecraft Dynamics and Control
Rigid body kinematics and spacecraft attitude descriptions. Attitude dynamics, motion about the center of mass, gravity gradient, and stability. Methods of attitude control both active (momentum exchange devices, thrusting) and passive (spin stabilization). Small and large angle feedback control laws. Attitude maneuvers of hybrid bodies containing both rigid and flexible components. Pre: AOE 5204, or permission of instructor.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

AOE 6254:
Intelligent Control
Intelligent control design of nonlinear systems, autonomous vehicles, including unmanned aerial vehicles, autonomous underwater vehicles, and spacecraft. Review of methods for stability analysis and robust control. Adaptive control design methodologies. Robustness of adaptive systems. Vision based sensors. Multivariable adaptive control. Output feedback methods.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

AOE 6774 (BMVS 5454) (ME 6574) (VM 8034) (ECE 6774):
Adaptive Control Systems
Introduction to the theory and methodology used to design adaptive controllers for uncertain systems, addressing issue such as input constraints, disturbance rejection, partial measurements, and robustness.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

AOE 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

AOE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

AGRICULTURAL AND APPLIED ECONOMICS

Kevin Boyle, Head

Professors: Jeffrey Alwang; Darrell Bosch; Kevin Boyle; Richard Crowder; George Davis; Michael Ellerbrock; Leighton Geyer; Mary Marchant; Bradford Mills; George Norton; David Orden; James Pease; Stephen Stephenson; Daniel Taylor;

Associate Professors: Dixie Dalton; Gordon Groover; Ruth Lytton; Achla Marathe; Everett Peterson;

Assistant Professors: Jason Grant; Christopher Parmeter; Jaren Pope; Hyrum Smith; Wen You;

General Contact: bfmills@vt.edu

Student Handbook: http://www.aaec.vt.edu/aaec/GraduateOverview.html

The Department of Agricultural and Applied Economics (AAEC) offers a very strong and growing graduate program. The program provides exciting study and research opportunities for students and has an outstanding record of graduate student placement. AAEC offers a M.S. in Agricultural Economics, with either an applied economics or agribusiness management and marketing focus, and a Ph.D. in Economics jointly with the Department of Economics. For the M.S. with applied economics focus, a student may select courses from a broad-based economics curriculum or may specialize in a specific field of interest. Students may develop specialties in diverse areas including, but not limited to, Econometrics and Quantitative Methods, Natural Resource and Environmental Economics, Management and Finance, Marketing and Price Analysis, International Development and Trade, and Rural and Regional Development. For the M.S. with agribusiness focus, students pursue specializations in management science, management, finance, or marketing. The M.S. with applied economics focus offers both thesis and non-thesis options. The M.S. with agribusiness focus is a non-thesis degree. 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.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GRE

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

M.S. degree: The general requirements for the master's degree thesis option are: (1) a minimum of 30 semester hours, including 24 hours of coursework and 6 hours of research and thesis (AAEC/ECON 5994), (2) completion of a thesis acceptable to the student's advisory committee, and (3) satisfactory performance on a final oral examination.The general requirement for a M.S. degree with applied economics focus non-thesis option is a minimum of 30 semester hours of coursework of which at least 24 hours must be at the 5000-level or above. For the M.S. degree, a student must also pass a final oral or written examination.The general requirements for the M.S. with agribusiness focus are (1) a minimum of 36semester hours, including 30 hours of coursework and 6 hours associated with developing and conducting a case study (AAEC/ECON 5904), and (2) satisfactory performance on a final oral 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.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

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

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

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

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

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

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

AAEC 5125 (HNFE 5694) (ECON 5125) (PHS 5044):

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

AAEC 5126 (PPWS 5064) (EDCI 5124) (ALS 5064) (MUS 5224) (BIOL 5064) (BCHM 5064) (ECON 5126) (PSCI 5115) (GIA 5115):

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

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

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

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

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

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

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

AAEC 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AAEC 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

AAEC 5945 (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 Vriginia. I,II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

AAEC 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

AAEC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

AAEC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

AAEC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

AAEC 6214:

Food and Health Mircoeconomics

Mircoeconomics of food and health. Overview of nutrition recommendations and implications for economic decisions. Indivual 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

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

AAEC 6304 (ECON 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

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

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

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

AAEC 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

AAEC 6564:

Robust Econometric Methods

Discussion and application of various methods to estimate economic models that are robust to a variety of common shortcomings inherent in classical models. Includes the use of quantile and median estimation, outlier detection, kernel smoothing, consistent model specification testing, nonparametric system and moment estimation, and bootstrap methods. Asymptotic theory necessary to understand the relative performance of estimators and tests will be thoroughly covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AAEC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

AAEC 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

AGRICULTURAL AND EXTENSION EDUCATION

Rickie Rudd, Head

Professors: Michael Lambur; Rickie Rudd;

Assistant Professors: Thomas Broyles; Eric Kaufman; Donna Moore; Kimberly Niewolny;

Community Viability Chair of Excellence: Rickie Rudd;

Graduate Contact: vkeith@vt.edu

Student Handbook: http://www.aged.vt.edu/Graduate/index.htm

The Department of Agricultural and Extension Education 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 AEE 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, extension program development and evaluation, and agricultural leadership.

SPECIAL FACILITIES

Virginia Tech's Department of Agricultural and Extension Education is located in three buildings on campus. In addition, we work with county extension offices and secondary schools across the state.

Femoyer Hall

Offices for the Residential Leadership Community are located in Femoyer.

Hutcheson Hall

The offices for our extension program development and evaluation unit are located in Hutcheson Hall.

Litton Reaves Hall

The main office for AEE is located in 2270 Litton Reaves. Many faculty offices and the offices for the Virginia FFA Association and the Virginia Agricultural Education Curriculum Specialists are also located in Litton Reaves. Our Teaching and Learning Laboratory is located in room 244. This sate 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 (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

The department offers two graduate degrees and partners in two other M.S. degree programs. The department offers an M.S. and a Ph. D. in Life Sciences with an emphasis in Agricultural and Extension Education (MSLFS). We are a partner in the College of Agriculture and Life Sciences for the MALS (Master of Agriculture and Life Science) 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. MSLFS/AEEThe Master of Science requires students to complete a thesis. 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, extension program development and evaluation, or leadership. MALS (education emphasis)The Master of Agriculture and Life Science is a non-thesis degree intended for practicing professionals in education and extension. This degree is delivered by distance to students who are place-bound. This is intended to be a terminal degree and not suited for students who intend to pursue a doctoral degree. Students are required to complete a comprehensive examination to complete the 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 AEE. 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 department offers two graduate degrees and partners in two other M.S. degree programs. The department offers an M.S. and a Ph. D. in Life Sciences with an emphasis in Agricultural and Extension Education (LSAE). We are a partner in the College of Agriculture and Life Sciences for the MALS (Master of Agriculture and Life Science) degree. In addition, we are a partner with the Virginia Tech School of Education in offering an M.S. degree for agriculture teacher certification M.S. CTE. Ph .D. LSAEThe Ph. D. program offered by AEE is intended for students who desire to be faculty in universities delivering comprehensive programs in agricultural and extension education. Our program focus allows us to deliver a customized program for students preparing for the professorate. 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, extension program development and evaluation, and leadership. 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 (AEE)

AEE 5034:

Teaching Agricultural Mechanics

The coordination of essential elements required for an effective agricultural mechanics program. Special emphasis placed upon integrating 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

AEE 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

AEE 5074:
Foundations of Agricultural and Extension Education
The history and philosophy of agricultural education and the cooperative extension service along with the inter-relationship of the two, including a common heritage. Leaders of both agencies, along with their philosophies, are discussed.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

AEE 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

AEE 5114:
Serving International Agriculture & 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

AEE 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

AEE 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

AEE 5764:
Externship in AEE
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

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

AEE 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

AEE 5964:

Field Study

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

AEE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

AEE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

AEE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

AEE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

AEE 7964:

Field Studies

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

AEE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

AGRICULTURAL AND LIFE SCIENCES

Douglas Pfeiffer, Head

Professors: Renee Boyer; Walter Daniels; Elizabeth Grabau; Donald Mullins; George Norton; Douglas Pfeiffer; Kerry Redican; Susan Sumner; Gregory Welbaum; Eric Wong;

Associate Professors: Antonius Baudoin; Carlyle Brewster; Dixie Dalton; Matthew Eick; Joseph Eifert; John Galbraith; William Hession; Sally Paulson; Holly Scoggins; James Westwood; Carl Zipper;

Assistant Professors: Thomas Broyles; Robert Williams;

Research Faculty: Cynthia Denbow;

Affiliated Faculty: Margaret Merrill;

General Contact: sproffit@vt.edu

General Contact: dgpfeiff@vt.edu

Student Handbook: http://www.online.cals.vt.edu/masters/

This degree program has been designed for potential students who are place-bound, whether because of professional or family commitments. This program is designed so that a student can successfully earn the degree without visiting the Blacksburg campus. Our program offers flexibility in several ways. Most courses are offered asynchronously; the student and instructor need not be on online at the same time. Courses and project are arranged to meet the goals of the 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. The student selects from a list of five concentration areas: (1) Biosecurity, Bioregulations and Public Health, (2) Education, (3) Environmental Science, (4) Food Safety, and (5) Plant Science and Pest Management. In addition to course work in the chosen Concentration Area, courses are required from a Core Curriculum.

SPECIAL FACILITIES

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The student designs a program of at least 30 credits. Nine of these must include courses in the core area. Each student selects 12 credits from the selected concentration area. One course is selected as an elective, generally from another concentration. Six credits are taken in the form of a project with report.

MSLFS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The student designs a program of at least 30 credits. Nine of these must include courses in the core area. Each student selects 12 credits from the selected concentration area. One course is selected as an elective, generally from another concentration. Six credits are taken in the form of a project with 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

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

ALS 5054:

Methodology in Nutrition Research

Use of laboratory techniques, instrumentation, and experimental design in the solution of fundamental problems in human and animal nutrition. Odd years. II

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

ALS 5064:

Seminar in Molecular Cell Biology and Biotechnology

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

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

ALS 5105:

Population Genetics

Principles of population genetics; gene frequency; forces that change gene frequency (migration, mutation, selection); genetic drift; biometric relationships between relatives; calculation of inbreeding and relationship; additive, dominance, and epistatic effects; estimation and use of repeatability, heritability, and genetic correlations; and formation and use of selection goals and selection criteria. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ALS 5106:

Population Genetics

Principles of population genetics; gene frequency; forces that change gene frequency (migration, mutation, selection); genetic drift; biometric relationships between relatives; calculation of inbreeding and relationship; additive, dominance, and epistatic effects; estimation and use of repeatability, heritability, and genetic correlations; and formation and use of selection goals and selection criteria. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ALS 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. Even years. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

ALS 5314:

Comparative Reproductive Physiology

Comparative mechanisms of all major aspects of male and female reproductive physiology will be examined in domestic animals, laboratory animals, and primates. Emphasis will be given to species variation in regard to reproductive function and to a detailed examination of key reproductive events in both sexes. II

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

ALS 5405:

Analysis of Animal Experiments with SAS

5405: Organization and management of data from animal experiments using Excel, JMP, and SAS. Emphasis on maintenance of data integrity and creation of datasets for statistical analyses, including formats, unit conversions, date and string functions, concatenation and merges, import and export data, and simple statistics. 5406: Use of Statistical Analysis System (SAS) procedures to analyze data from animal experiments. Topics covered will include SAS strategies and options for exploratory statistics, regression, ANOVA, mixed models, and repeated measures from several designs. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

ALS 5406:

Analysis of Animal Experiments with SAS

5405: Organization and management of data from animal experiments using Excel, JMP, and SAS. Emphasis on maintenance of data integrity and creation of datasets for statistical analyses, including formats, unit conversions, date and string functions, concatenation and merges, import and export data, and simple statistics. 5406: Use of Statistical Analysis System (SAS) procedures to analyze data from animal experiments. Topics covered will include SAS strategies and options for exploratory statistics, regression, ANOVA, mixed models, and repeated measures from several designs. Graduate standing required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

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

ALS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ALS 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ALS 5964:

Field Study

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

ALS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ALS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

ALS 6024:

Topics in Molecular Cell Biology and Biotechnology

Specific areas such as the molecular biology of plant and animal disease resistance, of photosynthesis, of oncogenes, of organelle assembly, and of growth and development, structure and function of polyamines and of proteases will be discussed. Students will give presentations and critically analyze current literature. May be repeated. I,II

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

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

ALS 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ALS 7964:

Field Studies

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

ALLIANCE FOR SOCIAL, POLITICAL, ETHICAL, AND CULTURAL THOUGHT

Francois Debrix, Program Director

Associate Professors: Brett Shadle;

Assistant Professors: Bettina Koch; Chad Lavin; Simon May; Rachel Scott; Rupa Thadhani;

Affiliated Faculty: Ananda Abeysekara; Brian Britt; Maria Elisa Christie; James Collier; Gary Downey; Edward Ewing; Elizabeth Fine; Jessica Folkart; Ellsworth Fuhrman; Matthew Gabriele; Laura Gillman; Heather Gumbert; Bernice Hausman; Stefanie Hofer; Parakh Hoon; Kathleen Jones; Gerard Kearns; Ann Kilkelly; Minjeong Kim; Neal King; James Klagge; Robert Leonard; Ilja Luciak; Timothy Luke; Marian Mollin; Wayne Moore; Amy Nelson; Scott Nelson; Philip Olson; Lydia Patton; Joseph Pitt; Karl Precoda; Anita Puckett; Barbara Reeves; Richard Rich; Michael Saffle; Emily Satterwhite; Benjamin Sax; Anju Seth; Richard Shingles; Robert Siegle; Barbara Smith; Robert Stephens; Max Stephenson; Ioannis Stivachtis; Daniel Thorp; Karen Till; Gerard Toal; Peter Wallenstein; Ronda Watson; Edward Weisband; Laura Zanotti;

University Distinguished Professor: Timothy Luke;

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

Alumni Distinguished Professor: Gary Downey;

General Contact: aspect@vt.edu

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

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 fifty faculty affiliates (see: www.aspect.vt.edu/q=node/1) 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 Relgion and Culture.

SPECIAL FACILITIES

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 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

ASPT 5244:

Constitutionalism in Theory and Practice

The course investigates theories and practices of constitutionalism, both within the United States and more generally. It frames a number of questions about what characterizes constitutionalism as a distinctive theory of politics, while also examining the constitution, maintenance, change, and destruction in practice of constitutional orders, constitutions, constitutional institutions, and other constitutional norms. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ASPT 5464 (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 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

ASPT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ASPT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

ASPT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

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

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

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

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

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

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

ASPT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

ANIMAL AND POULTRY SCIENCES

David Gerrard, Head

Professors: Donald Denbow; David Gerrard; Allen Harper; James Knight; Mark McCann; Edward Smith; Eric Wong;

Associate Professors: Joseph Eifert; Mark Estienne; Dan Eversole; Scott Greiner; Honglin Jiang; Ronald Lewis; Audrey McElroy; Rebecca Splan; Cynthia Wood;

Assistant Professors: Rami Dalloul; Jeffery Escobar Monestel;

Affiliated Faculty: Virginia Crisman;

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

General Contact: rmlewis@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, molecular biology, muscle biology, nutrition, physiology, and product quality assurance. M.S. students may also specialize in the area of livestock or poultry management. 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 23 faculty members who serve the needs of about 500 undergraduate and about 40 graduate students.

SPECIAL FACILITIES

State of the art research laboratories supporting all areas of graduate research are located in Litton Reaves on campus. Livestock facilities are located on the campus, at the nearby Kentland farm and at outlying agricultural research and extension centers across the state. Biosafety Level 2 animal research facilities are located in Litton Reaves on campus. On campus, a 200-ewe sheep flock, a 225-cow beef herd, a 60-sow swine herd, a five-building turkey center with facilities for >2,000 young and 1,500 adult chickens, and a herd of about 75 horses provide resources for teaching and research. 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. The Middleburg Agricultural Research and Extension Center, near Washington, D.C., is the centerpiece for a unique program in equine forage nutrition. Extradepartmental facilities also contribute importantly to the overall program of the Department. These include comprehensive data processing facilities maintained by the Computer Center, an electron microscopy laboratory, DNA sequencing facility, animal health and physiology laboratories in the Virginia-Maryland Regional College of Veterinary Medicine, and embryo manipulation and microinjection facilities for production of transgenic animals in the Department of Dairy Science. The Fralin Biotechnology Center has a shared confocal microscope facility.

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 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. Non-thesis option must include Project and Report: 6 hours minimum; minimum graded graduate credits for non-thesis option: 24.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

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 3.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

APSC 5044 (PPWS 5044):

Biotechnology in Agriculture and Society

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

APSC 5054G:

Advanced Genomics

Contemporary analysis of the development, utility and application of high-resolution methods for the study and manipulation of the complete

genomes of organisms. The use of new techniques for genomic, metabolic and protein engineering (functional genomics), including high-throughput methods and nanotechnology will be emphasized. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

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

APSC 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

APSC 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

APSC 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

APSC 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

APSC 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

ARCHITECTURE

William Galloway, Head

Professors: Salahuddin Choudhury; Donna Dunay; Robert Dunay; Jaan Holt; James Jones; Ronald Kemnitzer; Susan Piedmont-Palladino; John Poole; Humberto Rodriguez-Camilloni; Hans Rott; Robert Schubert; Mehdi Setareh; Joseph Wang; Frank Weiner;
Associate Professors: Kathryn Albright; Markus Breitschmid; Mario Cortes; Edward Dorsa; David Dugas; Kay Edge; Paul Emmons; Michael Ermann; Marcia Feuerstein; William Galloway; Howard Gartner; William Green; Dennis Jones; Shelley Martin; Margarita McGrath; Vance Pittman; Mark Schneider; Terry Surjan; Gregory Tew; Steven Thompson; Lisa Tucker; Mitzi Vernon; Joseph Wheeler;
Assistant Professors: Hilary Bryon; Elizabeth Grant; Helene Renard; Akshay Sharma;
Emeritus Faculty: Dayton Egger;

Graduate Coordinator: garch@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

Research and Outreach Centers

Center for High Performance Learning Environments

The Center for High Performance Learning Environments (CHPLE) serves as a resource for designers, engineers, system consultants, teachers, school administrators, facility managers, and others interested in improving the design and operation of K through 16 learning environments.

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.

Henry H. Wiss Center for Theory & History of Art & Architecture

The Henry H. Wiss Center for Theory and History of Art and Architecture gathers and actualizes interests in teaching, study and research of contemporary and historic art and architecture and theory.

International Archive of Women in Architecture

The International Archive of Women in Architecture (IAWA) documents the work of women architects and designers.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (220.0)

iBT: (90.0)

Master of Science in ArchitectureThe 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 environmental systems 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 daylighting; natural ventilation and air flow; indoor air quality; acoustics and theater design; and building structure, assembly, and/or economics. Industrial Design: This graduate program option offers students with architecture, design, and other undergraduate design experience, an opportunity to pursue a course of studies in industrial design. Its purpose is to provide a research focus for solving design problems, as well as a framework to achieve professional competency in the field. The option is concerned with the evaluation and application of human factors and environmental/behavioral research in the design and development of products and product environments for home, institutional, and transportation settings. It seeks to establish a better understanding of the critical interface between user needs, equipment and related space, and to apply this knowledge in the design of safe, efficient, and comfortable products and product environments. Students conduct independent and group research, participate in seminars and group projects of institutional, government and commercial sponsorship, or theoretical nature, and must produce a research-based thesis for graduation. Computing and Representation: Students working in this concentration will study how the design process can be described, how we represent things to ourselves and others by various notation schemes, how computers can support a design process in designing, learning, analyzing, and programming, computer capability in representation, and what organization is required for paint, line-drawing, and spatial modeling programs. Since a large group of faculty in the college is engaged in the development of an integrated computer support system for design, there is opportunity for students in this area of concentration to be engaged directly in the development of such a system, and to participate intensively in discussions concerning its organization. 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. 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 (National Capital Region, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 normally 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.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

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

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

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

ARCH 5046:

Environmental Design Research I, II

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

ARCH 5055:

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

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

ARCH 5064:

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

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

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

ARCH 5124:

Land Development for Constructed Facilities

This course covers how to get a piece of undeveloped Real-estate from idea to the finished product. It discusses the construction management interface between Site Engineering and Real-estate Marketing. Topics covered include: market influences, working with regulatory agencies, zoning, economic considerations, developing an optimum plan, cost and schedule, engineering requirements, environmental impact, financing, and delivering a final product. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

ARCH 5515:

Architecture and Systems Laboratory

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

ARCH 5516:

Architecture and Systems Laboratory

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

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

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

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

ARCH 5624 (LAR 5624) (UAP 5624):

Urban Design Seminar

Current topics in urban design. Topics may include: theoretical, conceptual and practical concerns in the generation of urban spatial form; the roles of public and private interests in shaping urban form; the effects of urban intensification on the quality of public spaces; environmental issues in urban design; the role of public policy and regulatory mechanisms; the genesis and development of urban typologies. Each seminar will address one of these or related subject areas. Course may be repeated with a different subject for a maximum of 12 credits. I,II.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

ARCH 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): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

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

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

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

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

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

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

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

ARCH 5756G:

Building Environmental Systems

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ARCH 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ARCH 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ARCH 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ARCH 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ARCH 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

ARCH 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

ARCH 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ARCHITECTURE AND DESIGN RESEARCH

William Galloway, Head

Professors: James Jones; Patrick Miller; Humberto Rodriguez-Camilloni; Mehdi Setareh; Joseph Wang;

Associate Professors: Markus Breitschmid; Paul Emmons; Marcia Feuerstein; Paul Kelsch; Mintai Kim;

Assistant Professors: Hilary Bryon; Elizabeth Grant; Mark Schneider;

Affiliated Faculty: David Lever;

Graduate Coordinator: garch@vt.edu

Graduate Chair: stthomp2@vt.edu

Blacksburg Program: wolverine@vt.edu

Alexandria Program: pemmons@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 Building Science, Industrial Design, Interior Design, and Landscape Architecture.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

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 (National Capital Region, Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Degree Requirements for the 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 PhD 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.

BIOCHEMISTRY

Peter Kennelly, Head

Professors: Dennis Dean; Peter Kennelly; Timothy Larson; Zhijian Tu;

Associate Professors: David Bevan; Erin Dolan; Glenda Gillaspy; Richard Helm; Jianyong Li; Robert White;

Assistant Professors: Marcy Hernick; Michael Klemba; Pablo Sobrado; Jinsong Zhu;

Affiliated Faculty: Carla Finkielstein; James Mahaney; Biswarup Mukhopadhyay; Florian Schubot;

Professor and Director, Fralin Life Sciences Institute: Dennis Dean;

General Contact: smearly@vt.edu

General Contact: edolan@vt.edu

Graduate Site: http://www.biochem.vt.edu/graduate.php

Student Handbook: http://www.biochem.vt.edu/graduatehandbook2010_final.pdf

The Graduate Program in the Department of Biochemistry at Virginia Tech prepares students for careers as independent researchers in biochemistry, molecular and cellular biology, biotechnology, and related areas. Training involves a combination of advanced course work, participation in seminars and journal clubs, teaching and K-12 outreach assistantships, 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, as well as science education. 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 preliminary examination, writing and defense of 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 beyond the standard postdoctoral training / university faculty path, including positions in industry, two-year and four-year colleges, 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 brand new 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 Molecular Cell Biology and Biotechnology 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.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (577.0)

Computer: (233.0)

iBT: (90.0)

GRE

General Test: Verbal (500.0), Quantitative (650.0)

Doctoral students take a set of ?core? courses and at least two specialized courses within their research track during their first two years. Students also complete laboratory rotations (first year) and seminars (all years). Specialized courses are suggested by research track: Vector Borne Disease and Signal Transduction, Protein Structure and Function, and Molecular Microbiology. 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. During the non-teaching semester, students are expected to take a higher course load: an additional, specialized required course. Successful 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 preliminary examination et 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 (500.0), Quantitative (650.0)

The Graduate Program in Biochemistry is a doctoral degree program. In rare instances, students may earn Masters degrees. M.S. 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

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

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

BCHM 5034G:

Advanced Environmental Health Toxicology

Health effects associated with the exposure to chemicals, identifying and managing problems of chemical exposure in the work place and the environment, fundamental principles of toxicodynamics and toxicokinetics, and risk assessment. Emphasis on conceptual understanding of chemical entry into the body, biotransformation, and elimination from the body. Identification of factors influencing environmental toxicoses and the overall risk to human health and ecological welfare from multiple classes of environmental toxicants. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

BCHM 5054:

Molecular Biology of Prokaryotic Gene Regulation

An analysis of the experimental design and methodology used to elucidate molecular regulation of prokaryotic gene expression. Modern genetic technologies used to identify and characterize these regulatory mechanisms will be emphasized. II. Alternate years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BCHM 5054G:

Advanced Genomics

Contemporary analysis of the development, utility and application of high-resolution methods for the study and manipulation of the complete genomes of organisms. The use of new techniques for genomic, metabolic and protein engineering (functional genomics), including high-throughput methods and nanotechnology will be emphasized. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

BCHM 5115:
Principles of Biochemistry
Comprehensive presentation of principles of protein structure, enzymology, bioenergetics, and metabolism. Relationships between regulatory mechanisms and molecular biology. Current literature on these topics provides emphasis on the relationship of primary scientific literature to biochemical knowledge. Biochemistry majors only. I,II
Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture

BCHM 5116:
Principles of Biochemistry
Comprehensive presentation of principles of protein structure, enzymology, bioenergetics, and metabolism. Relationships between regulatory mechanisms and molecular biology. Current literature on these topics provides emphasis on the relationship of primary scientific literature to biochemical knowledge. Biochemistry majors only. I, II.
Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture

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

BCHM 5204:
Molecular Biology of Eucaryotic Gene Expression
Mechanisms controlling eucaryotic gene expression. Topics include biochemistry and metabolism of DNA and RNA, gene and chromatin structure, enzymology of replication and transcription, modification and processing of RNA, recombinant DNA and molecular cloning techniques. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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 site-directed mutagenesis. Development and interpretation of kinetic rate equations. Theory and models of enzymatic catalysis. II. Alternate years.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BCHM 5344 (CS 5474) (MATH 5474) (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

BCHM 5454:
Biochemistry and Molecular Biology of Anaerobic Organisms
Contemporary analysis of the biochemistry, genetics, and ecology of strictly anaerobic organisms with emphasis on metabolism as it influences ecological niche and elicits the beneficial and deleterious effects on mankind; techniques to achieve anaerobiosis; role of anaerobic organisms in disease and industrial processes; genome structure of selected anaerobes.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture

BCHM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

BCHM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BCHM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BCHM 6004:

Advanced Topics in Biochemistry

Advanced topics of current interest selected from the current literature. May be repeated. I

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

BCHM 6024:

Topics in Molecular Cell Biology and Biotechnology

Specific areas such as the molecular biology of plant and animal disease resistance, of photosynthesis, of oncogenes, of organelle assembly, and of growth and development, structure and function of polyamines and of proteases will be discussed. Students will give presentations and critically analyze current literature. May be repeated. I,II

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BCHM 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BIOLOGICAL SCIENCES

Brenda Winkel, Head

Professors: Ernest Benfield; Arthur Buikema; Donald Cherry; Klaus Elgert; Joseph Falkinham; Khidir Hilu; Robert Jones; Liwu Li; Erik Nilsen; Brent Opell; John Phillips; David Popham; Jill Sible; Ann Stevens; John Tyson; Jeffrey Walters; Jackson Webster; Brenda Winkel;

Associate Professors: Christopher Lawrence; Maria Lazar; Stephen Melville; Ignacio Moore; Bruce Turner; Richard Walker; Zhaomin Yang;

Assistant Professors: Diya Banerjee; John Barrett; Lisa Belden; Daniel Capelluto; Daniela Cimini; Carla Finkielstein; Dana Hawley; Jeffrey Kuhn; Birgit Scharf; Florian Schubot; Dorothea Tholl; Jianhua Xing;

Alumni Distinguished Professor: Arthur Buikema;

University Distinguished Professor: John Tyson;

Harold Bailey Professor: Jeffrey Walters;

Graduate Contact: BiologyGrad@vt.edu

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

Graduate Course Descriptions: http://www.biol.vt.edu/graduate/courses.html

The Department of Biological Sciences offers research and training that leads to the M.S. and Ph.D. degree. Graduate students craft programs of study that include a cutting edge research project, courses that support their particular interests, and at least one semester of a teaching experience in consultation with their research sponsor and a faculty advisory committee. Opportunities for research span the biological disciplines from molecular biology to ecosystem ecology and include computational, experimental, theoretical, and applied approaches. Our faculty and staff encourage graduate students to reach their full creative and scholarly potential. We take a holistic approach to graduate education by considering not just research skills, but also the ability to communicate effectively with their 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 explore the research programs of potential sponsors. Faculty members maintain web pages that present their research activities. Contacting individual faculty and their students prior to formal application provides an opportunity to explore mutual interests.

SPECIAL FACILITIES

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Combined (Verbal & Quantitative) (1000.0)

M.S. must take at least 12 hours at the 5000 level, 3 hours at the 4000 level are allowed, and 3 additional hours for seminars for a total of 18 graded hours, plus 12 hours research and thesis. Thesis is required. All biology 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

General Test: Combined (Verbal & Quantitative) (1000.0)

Ph.D. must take 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 biology 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

BIOL 5034:

Ecosystem Dynamics

Application of a systems perspective to functional characteristics of ecosystems. Laboratory: computer simulation of ecosystem dynamics. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

BIOL 5044:

Aquatic Ecotoxicology

Techniques for evaluating polluted aquatic ecosystems, including laboratory toxicity testing and field biological monitoring, and the development of criteria for maintaining water quality. II

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

BIOL 5064:

Seminar in Molecular Cell Biology and Biotechnology

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

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

BIOL 5084:

Groundwater Ecology

Application of hydrologic and ecological principles to groundwater environments to address the biodiversity and processes of subsurface aquatic ecosystems. Recitation: assessment of primary literature directed at the ecology of groundwater systems. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

BIOL 5094:

Stable Isotopes in Ecology

Application of stable isotope methods and interpretations to studies of ecosystem structure and function. Recitation: critical assessment of contemporary literature and research themes associated with applications of stable isotopes to ecological research. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

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

BIOL 5114G:

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 the 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-requisite: Graduate Standing required
Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture

BIOL 5134G:

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. Graduate standing required.
Credit Hour(s): 4
Lecture Hour(s): 4
Instruction Type(s): Lecture

BIOL 5164:

Biology Seminar Lab

A practicum in the preparation and presentation of formal scientific seminars. Graduate standing required. II
Credit Hour(s): 1
Lecture Hour(s):
Instruction Type(s): Lab

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

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

BIOL 5214:

Plant Systematics

Analysis of plant variation and relationships, using morphology, cytogenetics, phytochemistry, molecular biology, and biogeography. Emphasis on breeding systems, polyploidy, hybridization, and speciation. II
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

BIOL 5304 (BMES 5304) (PPWS 5304) (CHE 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): 0 OR 4
Lecture Hour(s): 0 OR 3
Instruction Type(s): Lab, Lecture

BIOL 5384:

Morphometrics

Study of shape and size in fossil and modern organisms with strong focus on quantitative methods and digital image analysis. Covers analytical methods (multivariate methods, Fourier analysis, geometric morphometrics), image processing, and software training (SAS, SAS/IML, and Imaging Software).
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

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

BIOL 5424 (CS 5424) (GBCB 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

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

BIOL 5624G:

Advanced Microbial Genetics

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

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

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

BIOL 5664G:

Advanced Virology

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BIOL 5674G:

Advanced 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. Graduate standing required.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture, Online Lecture

BIOL 5804G:

Adv Prokaryotic Diversity

The study of the vast array of physiological, morphological, and behavioral properties of prokaryotes, i.e., the Bacteria and the Archaea, that enables them to compete successfully in nature and, in many instances, to complement each other. Topics covered include the modern classification of prokaryotes and show how their widely diverse properties have contributed to a better understanding of cell and molecular biology and biochemistry, how they have been useful in industry and agriculture, and how they are important for continued life in our biosphere. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

BIOL 5864:
Physical Chemistry of the Cell
Applications of classical thermodynamics, chemical kinetics, and ststistical mechanics in molecular and cellular processes. Pre-Requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

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

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

BIOL 6024:
Topics in Molecular Cell Biology and Biotechnology
Specific areas such as the molecular biology of plant and animal disease resistance, of photosynthesis, of oncogenes, of organelle assembly, and of growth and development, structure and function of polyamines and of proteases will be discussed. Students will give presentations and critically analyze current literature. May be repeated. I,II
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

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

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

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

BIOL 6644:

Topics in Microbial Genetics

Readings and discussion in a specific area of microbial genetics, including temperate bacteriophage, insertion elements and transposons, gene function in prokaryotic microorganisms, and mechanisms of genetic recombination. 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

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

BIOL 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BIOL 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BIOLOGICAL SYSTEMS ENGINEERING

Mary Leigh Wolfe, Head

Professors: Foster Agblevor; Theo Dillaha; Robert Grisso; Saied Mostaghimi; David Vaughan; Mary Leigh Wolfe;

Associate Professors: Justin Barone; Brian Benham; Conrad Heatwole; William Hession; Parameswaran Mallikarjunan; Chenming Zhang; Yiheng Zhang;

Assistant Professors: Jactone Ogejo; David Sample; Durelle Scott; Ryan Senger; Theresa Wynn;

Research Faculty: Leigh Anne Krometis; Eugene Yagow;

Emeritus Faculty: John Cundiff;

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

General Contact: bseacademics@vt.edu

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

The Biological Systems Engineering (BSE) program provides students with an opportunity to combine their interests in biological sciences and engineering. While there are many specialty areas within the discipline, the graduate program in BSE focuses primarily in two areas: Bioprocess Engineering and Land and Water Resources Engineering. Bioprocess engineering focuses on the design and development of processes for environmentally responsible manufacturing of biobased products from biological materials. Areas of interest include bioenergy, renewable materials, metabolic engineering, protein recovery, byproduct management and utilization, food engineering, biopharmaceuticals, enzymes, systems biology, bioinformatics, and biocatalysis.Land and Water Resources Engineering focuses on environmental protection and natural resources management. Areas of interest include nonpoint source pollution, ecological engineering, stream restoration, low impact development, hydrology, stormwater management, pollutant fate and transport, and watershed management.

SPECIAL FACILITIES

Bioprocess Engineering

Biofuels Laboratory, 411 Latham Hall (P. Zhang) Bioresource Engineering Laboratory I, 117 Seitz Hall (F. Agblevor) Bioresource

Engineering Laboratory II, 312 Latham Hall (F. Agblevor) Bioresource Management and Utilization Engineering Laboratory, 200 Founders Building, Corporate Research Center, 1800 Kraft Drive (J. Arogo Ogejo) Food Process Engineering Laboratory, 115B Seitz Hall (K. Mallikarjunan) Metabolic Engineering Laboratory, 107 Seitz Hall (R. Senger) Protein Engineering and Separation Laboratory, 115A Seitz Hall (M. Zhang) Renewable Materials Laboratory, 324 Latham Hall (J. Barone)

Land and Water Resources Engineering

Ecological Engineering Laboratory, 113 Seitz Hall (T. Wynn) Hydroecology Laboratory, 107A Seitz Hall (D. Scott) Prices Fork Research Facility, Prices Fork Research Farm (T. Wynn) Stroubles Creek Field Station, located near campus for stream and watershed research Water Analysis Laboratory, 106 Seitz Hall (D. Scott) Watershed Assessment Laboratory, 400 Seitz Hall (B. Benham)

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 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 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 5114:

Physical Properties of Agricultural Products

Theory and measurement of fundamental physical and engineering properties important to handling, modifying, processing, and and characterizing biological materials. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

BSE 5244 (BMES 5514) (CEE 5244) (ME 5714):

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

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

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

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

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

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

BSE 5604:

Advanced Food Process Engineering

Design of food processing operations including microwave cooking, frying, and extrusion. New food processing technologies including ohmic, radio frequency, high pressure, and pulsed electric field processing. Simulation of food processing systems. Procedures for optimizing formulations or processes. Odd years. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BSE 5614:

Advances in Recombinant Protein Production

Concepts, principles and applications of various expression systems for recombinant protein production, and the principles and applications of the most current unit operations used in bioseparations. The principles and applications of various methods for protein molecular modification to facilitate its downstream processing. Design of processes for protein purification based on expression systems, protein properties, and the impurities to be eliminated. Case studies in recombinant protein expression, recovery and purification. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

BSE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BSE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

BSE 5944:

Seminar

Selected presentations and discussions by graduate students and faculty.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

BSE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

BSE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

Instruction Type(s): Lecture

BSE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BSE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BIOMEDICAL AND VETERINARY SCIENCES

Roger Avery, Head

Professors: S Ahmed; Virginia Buechner-Maxwell; Gregory Daniel; Marion Ehrich; Francois Elvinger; Martin Furr; David Hodgson; Thomas Inzana; Karen Inzana; Martha Larson; Michael Leib; David Lindsay; Xiang-Jin Meng; Edward Monroe; David Panciera; James Pickett; Beverly Purswell; Nammalwar Sriranganathan; Kenneth Sullins; Gregory Troy; Nathaniel White; William Whittier; Jeffrey Wilcke;
Associate Professors: Jonathan Abbott; John Dascanio; Ian Herring; William Huckle; Bradley Klein; Otto Lanz; Yong Lee; Harold McKenzie; Kevin Pelzer; Bess Pierce; William Pierson; Paul Roberts; John Rossmeisl; Geoffrey Saunders; William Scarratt; William Swecker; Sharon Witonsky; Anne Zajac;

Assistant Professors: Jennifer Barrett; David Caudell; Linda Dahlgren; David Grant; Tisha Harper; Tanya LeRoith; Carolina Ricco Pereira; Elankumaran Subbiah; Reid Tyson; Nicole Weinstein; Lijuan Yuan; Kurt Zimmerman;

Research Faculty: Willard Eyestone; Theresa Hrubec; Liwu Li; Mary Prater; Christopher Reilly;

Graduate Contact: bjones57@vt.edu

Biomedical & Veterinary Sciences: http://www.vetmed.vt.edu/acad/grad/

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

Biochemistry/Pharmacology

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)

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, Leesburg)

TOEFL

Paper: (570.0)

Computer: (230.0)

iBT: (90.0)

GRE

Verbal and Quantitative : Combined Score (1070.0)

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 9085):

Emerging Infectious Diseases

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

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

BMVS 5034G:

Advanced Environmental Health Toxicology

Health effects associated with the exposure to chemicals, identifying and managing problems of chemical exposure in the work place and the environment, fundamental principles of toxicodynamics and toxicokinetics, and risk assessment. Emphasis on conceptual understanding of chemical entry into the body, biotransformation, and elimination from the body. Identification of factors influencing environmental toxicoses and the overall risk to human health and ecological welfare from multiple classes of environmental toxicants. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

BMVS 5054 (VM 8124) (VM 9095):

Veterinary Virology

Study of general virology, e.g. classification, physico-chemical characteristics, replication, recognition of and immune response to members of different viruses families. Study of clinical signs, pathology, histopathology, prevention and diagnosis of animal virus diseases by species of animals. II

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

BMVS 5084 (CHEM 5084) (FST 5084):

Macromolecular Interfaces with Life Sciences Seminar

Experience in developing and presenting a technical seminar related to oxidative processes at the macromolecule- biomolecule interface. Tours and presentations at research facilities at regional industrial sites. Idea generation for the purpose of resolving technical questions and advancing research projects. 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): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

BMVS 5094 (PSCI 5564) (GIA 5564) (CHEM 5094) (FST 5094) (WS 5564):

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. (3H, 3C) Graduate standing required. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

BMVS 5174:

Scientific Integrity

Issues relating to scientific integrity and the responsible conduct of study as related to research in the biological, veterinary, animal and natural sciences. The topics covered include methods, ethics and the scientist, mentoring, authorship and peer review, use of humans and animals in experimentation, managing conflicting interests, collaborative research, ownership of data and intellectual property, genetic technology, scientific record keeping. Pre-requisite: Completion of one year of graduate coursework

Credit Hour(s): 2

Lecture Hour(s): 3

Instruction Type(s): Lecture

BMVS 5184G:

Advanced Medical Toxicology

Adverse health effects of exposure to drugs or substances of abuse. Covers principles of toxicodynamics, toxicokinetics, biotransformation, diagnosis and treatment. Emphasis will be placed on mechanism(s) of action of the various drug classes, body system(s) affected, clinical manifestations of problems and the resulting adverse affects on human health and society. Methods of treatment and client education will also be addressed. Laws controlling and governing the use of these drugs/substances and the agencies responsible for them will also be covered. Cross-listed with VM 9204. Graduate standing required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

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

BMVS 5204:

Advanced Veterinary Cytology

Advanced course in veterinary cytologic interpretation. Selected cytologic specimens of normal and diseased tissues are examined microscopically, described and interpreted. Course may be taken more than once. (Maximum 4 credits). DVM degree and permission of instructor required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

BMVS 5214:

Pharmcology and Toxicology Testing

Procedures and methods used to approve new drugs and chemicals for marketing. Experimental design, practical considerations, legal requirements, evaluation of general and specific toxicology testing methods, risk assessment, and prospects for changes in current testing methods will be covered. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

BMVS 5244 (VM 8314):
Veterinary Pharmacology
Principles of pharmacodynamics and pharmacokinetics, including interaction of drugs with receptors; their absorption, distribution and clearance; drug metabolism and drug interactions. Study of drugs by pharmacological classes, their general mechanisms of action, usefulness and side effects. Also, pharmaceutical calculations and prescription writing. I
Credit Hour(s): 0 OR 5
Lecture Hour(s): 0 OR 4
Instruction Type(s): Lab, Lecture

BMVS 5254 (VM 8424):
Veterinary Toxicology
Study of toxic agents, mechanisms and action, toxicoses, and treatments, especially as related to domestic and wild animals. Principles of toxicity testing and clinical diagnosis. Second-year standing in the DVM curriculum is required.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture

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

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

BMVS 5305 (VM 8124) (VM 9095):
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

BMVS 5306:
Veterinary Oncology
These companion courses are designed to provide intensive study of the biology of neoplasms, their diagnosis, clinical presenation 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 DVM curriculum.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

BMVS 5314:
Membrane Physiology
General topics of membrane physiology. Emphasis on mechanisms involved in the transduction of extracellular signals into physiological changes within the cell. Specific topics include: receptor-agonist interactions, phos-phatidylinositol turnover, changes in the concentrations of intracellular free calcium and/or cyclic AMP, protein kinase C, and prostaglandins.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture

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

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

BMVS 5384 (FST 5384) (HNFE 5724) (CHEM 5384) (PHS 5024):

Oxidation at the Interface of Chemistry and Biology

An advanced survey of the chemistry and biochemistry associated with oxidation reactions and the relationship to positive and detrimental outcomes in synthetic and natural macromolecules and biological systems. Topics include free radical chemistry, reactive oxygen and nitrogen species in living systems, enzyme-catalyzed oxidations, oxidation of foods and materials, oxidative stress and health effects, chemistry of antioxidants. 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BMVS 5414:

Reproductive Cell Biology

Detailed study of the processes of gamete production, gamete maturation, fertilization, and early embryo pre-implantation development, by analysis of the known molecular changes which gametes and embryos undergo. Emphasis will be on oocyte maturation, sperm capacitation, and embryo development through blastocyst. Extensive use of current literature.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BMVS 5434 (ECE 5504) (VM 8014) (CS 5504):

Veterinary Anatomy I

Study of the basic structural and functional anatomy of carnivore (dog, cat), horse, and ruminants. Gross morphology is applied to clinical diagnosis, interpretation, surgical and medical treatment. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

BMVS 5444 (VM 8264) (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

BMVS 5454 (AOE 6774) (ME 6574) (VM 8034) (ECE 6774):

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

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

BMVS 5474 (VM 8384) (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

BMVS 5514:

Musculo-skeletal Surgical Advanced

Myology, arthrology, osteology and biomaterials will be reviewed to provide state of the art information to graduate veterinarians. Research directions and trends will be stressed. Laboratory experience with selected problems. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

BMVS 5524:

Veterinary Clinical Nutrition Consultation

The Veterinary Clinical Nutrition Consultation course provides graduate students with clinical experience in clinical nutrition of small and large animal species. Students will be assigned clinical consults in nutrition from cases presented to the small and large animal hospital and from field services (AHS and PMM) at the VMTH. The student will be responsible for documenting the consult for the medical records. The student will participate in clinical rounds in the different service areas at the VMTH on a rotational basis. Repeatable with maximum of 6 credits. DVM degree required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

BMVS 5534:

Topics in Advanced Small Animal Gastroenterology

In-depth study of small animal gastrointestinal medicine. The student will be exposed to both common and uncommon disorders of the gastrointestinal system. Gastrointestinal controversies will be explored. DVM degree required. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BMVS 5544:

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

BMVS 5554:

Advanced Surgery of the Special Senses and Skin

Conceptual and practical development of surgical principles and progress that have occurred in recent years within these fields. Neurology, ophthalmology, audiology, and dermatology will be considered from a surgical perspective. Current problems and research areas will be reviewed. Laboratory manipulations are used to increase skill levels in these areas. DVM degree required. III

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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

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

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

BMVS 5654 (VM 8454):

Veterinary Clinical Nutrition

This course considers the nutritional needs of species of veterinary importance throughout life and for various work-loads and purposes. Nutritional management of diseased or compromised patients is considered. Pre: second-year standing in the DVM curriculum or completion/test-out of VM 8234 or equivalent course.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

BMVS 5734 (VM 8414):

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

BMVS 5754 (VM 8334):

Veterinary Bacteriology and Mycology

Study of important bacterial and mycotic agents that cause disease of economic and public health significance in food and fiber, companion, laboratory and zoo/wildlife animal species. Special emphasis is on: habitat, microbial characteristics, virulence attributes, pathogenesis, immunity, approaches to prevention, antimicrobial susceptibility and diagnosis. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

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

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

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. Features to be discussed will largely be those that adapt the animal group to its habitat and permit successful exploitation of that habitat; the discussion will extend to how anatomical features and functions are utilized in the life of members of the group. On completion of discussion of pertinent anatomical features, selected attributes of the group's natural history will be covered, as well as a brief survey of members of the group common to the local and extended area. Pre: first-year standing in the DVM curriculum.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

BMVS 5824 (VM 8264) (VM 8114):

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

BMVS 5834 (VM 8384) (VM 8104):

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

BMVS 5844 (VM 8394):

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

BMVS 5864 (VM 8754):

Veterinary Cardiorespiratory System

This course concentrates on respiratory and cardiovascular diseases of the common domestic species. Emphasis is given on teaching students how to develop a data base for these two body systems using effective communications and modern diagnostic tools. The course focuses on the common diseases of these systems and how these diseases are managed and treated. Pre: second-year standing in the DVM curriculum.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BMVS 5874:

Food Animal Theriogenology

Presents the practice of food animal theriogenology for individuals interested in working within food animal production systems. The course will include reproductive management for herds of food animal species including cattle, sheep, goats and swine. Emphasis is on clinical aspects of reproductive diseases and management. Consists of lectures, laboratories and discussion groups. Pre: VM 8374 or equivalent. Graduate standing required.
Credit Hour(s): 0 OR 2
Lecture Hour(s): 0 OR 1
Instruction Type(s): Lab, Lecture

BMVS 5884:

Macromolecular Chemistry at the Biology Interface Laboratory

An advanced laboratory course that involves state-of-the-art experimental techniques with applications for data interpretation and presentation for future professionals at the polymer chemistry-biology interface. Team-oriented experiments will use traditional and emerging polymer chemistry techniques and applied biological methods, specifically those involving analysis of free radical and oxidative processes. PRE: CHEM/FST/BMVS 5384 or simultaneous enrollment in this course.

Credit Hour(s): 0 OR 2

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

BMVS 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

BMVS 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BMVS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

BMVS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BMVS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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

BMVS 6114:
Topics in Pathogenic Bacteriology
Journal articles on the molecular basis of bacterial pathogenesis published in the past year will be reviewed and discussed. While the emphasis will be on bacterial factors responsible for disease or virulence, papers on host factors responsive to bacterial infection may also be reviewed. Papers will be assigned by the instructors and chosen by the students. The topics will vary and the course may be taken for credit no more than 3 times. Graduate standing required.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

BMVS 6514 (VM 8514):
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

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

BMVS 6554 (VM 8684):
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

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

BMVS 6574 (VM 9214):
Animals and Public Policy
Course will examine society's changing attitudes toward the care and use of animals and examine the philosophical spectrum between animal welfare and animal rights. Will explain the role of the major regulatory and accrediting organizations in setting standards of care for animals used in research, exhibition, transportation, and production. Will describe the regulatory process for making policies and regulations to support federal legislation. Will provide information on the currently acceptable standards for the care and use of animals for regulated purposes. Pre: third-year standing in the DVM curriculum.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

BMVS 6584 (STS 6334) (PHIL 6334) (VM 9234):

Veterinary Public Policy

Overview of the formulation and implementation of public policy at the local, state, and national level through legislation, regulation, and operational strategy. Understanding of the concepts of legal authority and public mandate. Training in risk communication and media relations. Review of current public policy issues related to veterinary medicine, animal and human health such as food safety, animal disease control, animal welfare, business practices. National leaders will interact with the class to discuss current issues. Pre: third-year standing in the DVM curriculum.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

BMVS 6594 (VM 9244):

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

BMVS 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

BMVS 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BMVS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BIOMEDICAL ENGINEERING

Stefan Duma, Head
Hampton Gabler, Associate Head
Craig Hamilton, Associate Head

Professors: Anthony Atala; George Christ; Thomas Diller; Stefan Duma; Michael Friedlander; Harold Garner; John Grant; Roop Mahajan; Maury Nussbaum; Peter Santago; Ge Wang;

Associate Professors: J Bourland; David Carroll; Hampton Gabler; Aaron Goldstein; Craig Hamilton; Warren Hardy; Thurmon Lockhart; Chang Lu; Michael Madigan; Michael Munley; Shay Soker; Joel Stitzel; Mark Van Dyke; Pavlos Vlachos; Chris Wyatt; James Yoo;

Assistant Professors: Bahareh Behkam; Rafael Davalos; Raffaella De Vita; Daniel Dudek; Joseph Freeman; Yaorong Ge; Benjamin Harrison; Robert Kraft; Yong Lee; Alexander Leonessa; Amrinder Nain; Padmavathy Rajagopalan; Christopher Rylander; M Rylander; Katherine Saul; Justin Saul; John Socha; Jessica Sparks; Anne Staples; Abby Whittington; Yong Xu; Hengyong Yu;

Research Faculty: Joel Berry;

Samuel Reynolds Pritchard Professor: Ge Wang;

Emeritus Faculty: Peter Eyre; Michael Furey; Festus Gray;

General Contact: tsentell@vt.edu

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

Admissions Information: http://www.sbes.vt.edu/admissions.php

Student Handbook: http://www.sbes.vt.edu/policies.php

The Virginia Tech-Wake Forest University School of Biomedical Engineering & Sciences (SBES) is a multi-disciplinary, multi-institutional graduate program that bridges engineering, science and medicine. The joint program combines the strengths and resources of Virginia Tech's College of Engineering, the Wake Forest University School of Medicine, the Virginia-Maryland Regional College of Veterinary Medicine and the new Virginia Tech Carilion School of Medicine to produce an environment that fosters graduate education and outstanding interdisciplinary research. SBES diplomas carry the seals of both Virginia Tech and Wake Forest University. Graduate students choose a home campus (Blacksburg or Winston-Salem) based on their preferred areas of concentration within biomedical engineering, or their choice of faculty whose research interests them. However, they are able to experience the environments and faculty of both locations through courses taught by video-broadcast and through inter-campus visits and events. Currently SBES offers four general areas of concentrations referred to as "theme areas". They are: Biomechanics Cell & Tissue Engineering Biomedical Imaging Medical Physics Students are encouraged to adhere to the theme area requirements specified by each faculty group; however, declaring a specific area is not required. The

SBES encourages innovative thinking and novel approaches to problem-solving, therefore it attempts to tailor the student's academic program to assist them with their individual goals and research ambitions. Please refer to www.sbes.vt.edu for further details regarding concentration requirements. The school anticipates offering additional specialty areas in the future as the program and faculty expand.

SPECIAL FACILITIES

On the Blacksburg campus SBES occupies the new Institute for Critical Technology and Applied Science building 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. 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 will be 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. SBES affiliated labs and research centers include:

Advanced Experimental Thermofluids Research Engineering Lab (AEthER) [Blacksburg]

The AEthER group specializes in the development and application of advanced and novel experimental fluid mechanics methods for spatio-temporally resolving complex thermo-fluids system.

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. We are located on the 3rd floor of the MRI building at Wake Forest University Baptist Medical Center. 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. PDF 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/pre-clinical potentials, and train the next generation of imaging scientists and engineers. Established in 2006 it consists of the bioluminescence tomography (BLT) laboratory, computed tomography (CT) laboratory, and the high-performance computer (HPC) laboratory. A balance is sought among theoretical studies, algorithm development, system prototyping, biomedical and other applications. website here

Biotransport and Optics Laboratory [Blacksburg]

The focus of the biomedical optics laboratory is studying dynamic heat and mass transport processes in biological tissues using non-invasive optical imaging techniques. Combining experimental and modeling techniques provides a better understanding of relationships between tissue thermophysical properties and light propagation. Knowledge gained can be used to design techniques and devices to increase penetration depth of light in tissue and improve optical diagnostic and therapeutic procedures. website here.

CT Colonography Research Group [Winston-Salem]

Computed tomographic colonography (CTC) is a minimally-invasive screening method for detecting polyps. Mixed success has been achieved in clinical trials, in large part due to variations in reader experience, the large number of images, and the complex geometry of the colon. Yet computer polyp detection (CPD) and computer-aided polyp detection (CAPD) promise to improve the sensitivity and specificity of CTC, similar to mammography and lung nodule detection. Our long term goal is to design and implement a high-performance pattern analysis system for CPD, incorporating more sophisticated pattern classification algorithms including and explicitly using both vertex and voxel representations. Additionally we seek to optimally combine prone and supine CTC scans and incorporate this method into the CPD system. 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 multi-disciplinary 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 automobile test dummies and computational modeling in order to develop human impact injury criteria. Website Here

Center for Molecular Medicine and Infectious Diseases [Blacksburg]

The central theme of CMMID is "Animal Model of Diseases". Our faculty specialize in using various animal models that include not only traditional laboratory animal models (mice and rats), but also non-traditional (chickens, pigs, dogs, fish, crab, equine) animal models. Our mission is to employ animal models to better understand the disease processes that impact both humans and domesticated species. A sound basic understanding of pathogens will enable us to better design newer intervention strategies, such as genetically altered vaccines and immunomodulators. 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.

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

Industrial Ergonomics & Biomechanics Lab [Blacksburg]

The Industrial Ergonomics and Biomechanics Laboratory conducts work in theoretical and applied ergonomics, occupational biomechanics, and work physiology, primarily relating to worksite, 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

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 readh areas previously explored in isolation.Â Website Here

Kevin P. Granata Musculoskeletal 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 field of musculoskeletal biomechanics. The primary focus of research conducted in the MBL is injury prevention, with projects falling into two main categories: Balance and Fall Prevention, and Low-Back and Spine Biomechanics. 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 biocompatible 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 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, Altzheimer'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

Locomotion Research Lab [Blacksburg]

The Locomotion Research Lab conducts research directed toward discovering ways to prevent falls among the elderly by investigating the relationship between aging and falling. Volunteer subjects are placed in a harness fitted with a network of sensors that test musculoskeletal and neuromuscular changes and biomechanical responses during slips and recoveries. They walk on an experimental platform where they are induced to slip and execute a recovery (an actual fall is prevented by the harness). All the data from the monitoring sensors is fed into a computer model, providing information about the submect's gait while walking and the motions involved slipping and recovery. Knowledge gained will contribute to the the reduction in numbers of deaths due to falls in the elderly -- numbers which have risen from 14,900 in the year 2000 to 17,700 in 2005. Website Here

Movement Biomechanics Lab (MoBL) [Winston-Salem]

The Movement Biomechanics Lab (MoBL) investigates the relationship between musculoskeletal structure and measured function in the upper limb. We use MR imaging, strength assessments, and functional testing in conjunction with computational simulation of the upper limb to characterize and investigate upper limb function and neuromuscular control in healthy and impaired populations of subjects. Website Here

Musculoskeletal Tissue Regeneration Lab [Blacksburg]

The Musculoskeletal Tissue Regeneration Lab (MTR) focuses primarily on the repair and regeneration of tissue, mainly musculoskeletal tissue, through the use of tissue engineering techniques. We also investigate mechanisms of tissue damage and healing, and molecular modeling of structural proteins. We create novel scaffolds for functional tissue engineering based on nanofiber, braiding, waving, hydrogel, and microsphere technology. Website Here

Nanotherapeutics and Bioheat Transfer Lab [Blacksburg]

The biomedical heat transfer lab is focused on understanding and controlling bioheat transfer at the cellular and tissue level. One major research area is dedicated to designing effective thermal therapies for cancer treatment. Novel techniques utilizing computational treatment planning modeling, magnetic resonance thermal imaging for feedback control, and nanoparticles (nanotubes and buckyballs) are being explored to enhance thermal therapies.

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.

Tissue Engineering Lab [Blacksburg]

The Tissue Engineering Laboratory explores methods for developing engineered bond 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, electospun 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

Vestibular Mechanics Laboratory [Blacksburg]

Our lab investigates the mechanics behind the stimulus of hair bundles in the utricle through experiments and finite element modeling. The utricle, an organ in the inner ear that contributes to one?s sense of balance, responds to changes in acceleration by a shearing of hair bundles contained within the layers of the utricle otoconial membrane (OM). Through experiments on and finite element models of both hair bundles and utricle OMs, we can discover how hair bundles are stimulated in-vivo and how mechanics of the utricle OM and the hair bundles can affect one's sense of balance.

WFUSM Bone and Joint Center [Winston-Salem]

The mission of the Wake Forest University Bone and Joint Center is to improve the quality of patient care for musculoskeletal conditions through the development of innovative research, patient management, and education strategies. Website Here

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

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg, Wake Forest)

GRE

General Test: Verbal, Quantitative, Analytical (4.0)

GRE COMBINED (V & Q): Combined score (1200.0)
IELTS

General: Band (7.0)
TOEFL

Paper: (600.0)

iBT: (100.0)

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. The distribution of required hours can be: 40 - 54 credit hours of research (7994-level only, VT) 36 - 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: 12 credits of engineering courses (BMES or from any engineering department) to include the required course, Quantitative Physiology 6 credits of graduate level mathematics, only 3 of which may be in statistics (see approved lists pertinent to each campus location) 7 credits of life science coursework, 4 of which are earned through the required course, Mammalian Physiology 2 credits from the required BMES 6064 Clinical Rotation (available only to PhD candidates) 9-23 credits in elective coursework, remainder of hours up to 90 in research PH.D. students must complete a required Medical Ethics module which, even though it carries 0 credits (is not a "course"), must be listed on the plan of study. They are required to attend 5 seminars per semester, documented by their advisors, every semester they are enrolled.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. Please refer to www.sbes.vt.edu for details regarding all degree requirements.

Degree Concentrations:

Biomechanics

The SBES faculty specializing in the theme area of Biomechanics offer research in such topics as: Impact injury biomechanics Cell & tissue biomechanics Computational modeling of impact injury Sports biomechanics Military restraint systems Traumatic aorta rupture and abdominal injury Neurotrauma Soft tissue biomechanics Gait biomechanics Work physiology and ergonomics Postural control and spinal stability Aging effects on physical activities Biomechanical modeling Experimental investigation of neural control Slips & falls and their prevention Cardiovascular mechanics Vestibular mechanics Cellular mechanics

Cell & Tissue Engineering

The SBES faculty specializing in the area of Cell & Tissue Engineering offer a broad spectrum of research in topics such as: Biomaterials Vascular stents Bioengineered arterial grafts Molecular modeling Musculoskeletal tissue regeneration Fluid dynamics Tissue engineering Biomaterials for targeted drug delivery Transport phenomena Irreversible electroporation Biomedical microdevices Biomedical applications of nanotechnology Cellular & molecular mechanisms of inflammatory vascular disease Modeling tissue heat and mass transport Thermal therapy design for cancer treatment Measurement/imaging of cellular and tissue protein expression Biomedical optics and imaging Modification of tissue optical properties

Biomedical Imaging & Medical Physics

The SBES faculty specializing in the areas of medical imaging and medical physics have research interests in specific topics such as: Advanced imaging and image analysis Digital signal processing, Virtual anatomical and functional visualization Magnetic resonance imaging CT colonoscopy Pattern classification and machine learning 3D radiation treatment planning 3D tumor volume analysis Uses of Pet-CT and MR in radiation treatment Bioluminescence tomography Fluorescence tomography X-ray computed tomography

MS Degree

Offered In (Blacksburg, Wake Forest)

TOEFL

Paper: (600.0)

iBT: (100.0)
GRE

General: Verbal, Quantitative, Analytical (4.0)
IELTS

General: Band (7.0)
GRE COMBINED (V & Q)

Combined score: Combined (1200.0)

The Master of Science degree requires a minimum of 30 total credit hours beyond the baccalaureate which must consist of: 7 - 9 credit hours of research (5994-level only, VT) 21 - 23 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 course, Quantitative Physiology 3 credits of graduate level mathematics which can be either pure math or statistics from approved lists on each campus (see website) 4 credits of life science, satisfied with the required course, Mammalian Physiology 5 - 7 credits in elective courses, the remainder up to 20 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 attend 5 seminars each semester, documented by the student's advisor, for all semesters attended. 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.

Degree Concentrations:

Biomechanics

The SBES faculty specializing in the theme area of biomechanics have research interests in topics such as: Impact injury biomechanics Cell & tissue injury biomechanics Computational modeling of impact imjury Sports biomechanics Military restraint systems Traumatic aorta rupture and abdominal injury Neurotrauma Soft tissue biomechanics Gait biomechanics Work physiology and ergonomics Postural control and spinal stability Aging effects on physical activities Biomechanical modeling Experimental investigation of neural control Slips & falls and their prevention Cardiovascular mechanics Vestibular mechanics Cellular mechanics

Cell & Tissue Engineering

The SBES faculty who work in the area of cell & tissue engineering have research interests in topics such as: Biomaterials Vascular stents Bioengineered arterial grafts Molecular modeling Musculoskeletal tissue regeneration Fluid dynamics Tissue engineering Biomaterials for targeted drug delivery Transport phenomena Irreversible electroporation Biomedical microdevices Biomedical applications of nanotechnology Cellular & molecular mechanisms of inflammatory vascular disease Modeling tissue heat and mass transport Thermal therapy design for cancer treatment Measurement/imaging of cellular and tissue protein expression Biomedical optics and imaging Modification of tissue optical properties

Biomedical Imaging & Medical Physics

The SBES faculty specializing in the areas of medical imaging and medical physics have research interests in topics such as: Advanced imaging and image analysis Digital signal processing Virtual anatomical and functional visualization Magnetic resonance imaging CT colonoscopy Pattern classification and machine learning 3D radiation treatment planning 3D tumor volume analysis Uses of Pet-CT and MR in radiation treatment Bioluminescence tomography Fluorescence tomography X-ray computed tomography

GRADUATE COURSES (BMES)

BMES 5004:

Mammalian Physiology

Cell biology, neurological and muscle physiology, autonomic nervous system, cardiovascular system, cardiac function & hormonal regulation, pulmonary system, renal system, endocrinology, gastrointestinal system, glucose and lipid storage for biomedical engineering students only.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

BMES 5014:

Quantitative Physiology

Mathematical modeling, simulation, quantitative description of organ physiology and control. Numerical simulation of physiologic processes. Cell resting membrane potential, and nerve and muscle tissue. Regulation of cardiac output, venous return, and closed-loop control. Pressure-volume behavior of alveoli and respiratory ventilation control. Nephron countercurrent mechanism, and hemodialysis. Metabolism, internal heat generation and temperature regulation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

BMES 5134:

Biomech & Sim Movement I

Key topics in movement biomechanics, including muscle physiology and mechanics, neural control, kinematic and dymanic modeling, and dynamic simulation. Disscussion of real-life application in medicine and sports, and practical experience using engineering equipment (motion capture and EMG) and software used in research and industry to analyze human movement. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BMES 5164 (STS 6314) (PHIL 6314) (ME 5754) (ME 6754):

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

BMES 5174:

Biomechanics of Crash Injury Prevention

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

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

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

BMES 5244:

Biofluids

Fluid dynamics of physiological systems with focus on the cardiovascular and the respiratory systems. The course will address: the heart, arterial blood vessels, airways; description of cardiac and pulmonary circulation; anatomy and function of the heart; anatomy and function of the respiratory system; mechanics of soft tissues; review of basic fluid mechanics; continuum mechanics and constitutive modeling; rheology of blood, Newtonian and non- Newtonian; Viscous flow in vessels, Navier-Stokes; mathematical analysis of pulsatile flow; pulse-wave propagation through vessels; particulate flows and particle transport in airways. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BMES 5304 (PPWS 5304) (CHE 5304) (BIOL 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

BMES 5334:

Cell Adhesion

Study of the mechanisms of cell-cell and cell-surface attachment, corresponding models to describe the kinetics of attachment and binding, and testing methods to assess the strength of cellular adhesion. The course includes the contributions of surface chemistry and morphology, receptor biology, and a series of modules showing the biophysics of cell adhesion in real systems. Graduate standing in Biomedical Engineering or other relevant disciplines in the biological sciences.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BMES 5344:

Skin: Properties, Function, and Bioengineering Applications

Study of the physical, mechanical, thermal, and diffusive properties of

skin using engineering principles. The relationship to diseases and damage as manifested in terms of differences in these properties is covered. Included among topics are age-related compositional changes, wounds and wound healing as well as using skin as an overall gauge of health. Graduate Standing in Biomedical Engineering or other relevant disciplines in the biological sciences.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BMES 5424:
Fundamentals of Tissue Structure, Function, and Replacement
Descriptions of the structures of tissues such as skin, bone, ligament, cartilage and blood vessels. Relationships between the structures of these tissues and their functions. Descriptions of the components of these tissues and their mechanical properties. Introduction to tissue mechanics and mathematical modeling of tissue behavior. Introduction to mechanical testing methods of hard and soft tissues. Methods for tissue replacement. Graduate standing required.
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture

BMES 5434 (PSCI 6224) (CHE 5214) (GIA 6224):
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

BMES 5514 (CEE 5244) (BSE 5244) (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

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

BMES 5526:
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

BMES 5554:
Biomedical Signal and Image Processing
The mathematical theory underlying the processing of one and two dimensional signals, including Fourier transforms, sampling, quantization, correlation, and filtering. For images, the topics of segmentation, restoration, enhancement, color, and registration will be explored. Matlab projects will be utilized extensively, with an emphasis on biomedical signals and images. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

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

BMES 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BMES 5944:

Seminar

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

BMES 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

BMES 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

BMES 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

BMES 6164 (STS 6314) (PHIL 6314) (ME 5754) (ME 6754):

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

BMES 6174:

Advanced Human Modeling: Injury and Tissue Biomechanics

Impact biomechanics and computational biomechanics, 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

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

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

BMES 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BMES 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BIOMEDICAL TECHNOLOGY DEVELOPMENT AND MANAGEMENT

Kenneth Wong, Program Director

Graduate Contact: jlefurgy@vt.edu

Graduate Site: http://www.btdm.gu.vt.edu/

The Master of Science in Biomedical Technology Development and Management is a joint graduate level degree created by Virginia Tech and Georgetown University in response to future directions in medical product discovery and development and the emerging needs of industry and regulatory agencies. Curriculum for the degree program integrates science with technology, management, ethics, and public policy, and draws on the strengths of Virginia Tech in science, industrial and systems engineering, business and management; and Georgetown's medical research program. Students may apply to and matriculate at Virginia Tech or Georgetown, but in either case, the instruction, tuition, and fees are identical and the degree will be jointly conferred from both universities.

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 Georgetown University campus in Washington, D.C. Our students pursue a capstone project during the second year in partnership with a corporation or research partner in the National Capital Region.

DEGREES OFFERED

MS Degree

Offered In (National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

The Master Of Science in Biomedical Technology Development and Management requires 30 semester hours. Each degree candidate must complete and successfully defend a research paper or a project and report -- demonstrating in-depth knowledge of a particular topic as well as the ability to analyze information, think critically, and communicate effectively.

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

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

BTDM 5234:
Pre-Clinical and Clinical Product Evaluation
This course will first introduce approaches to preclinical drug evaluation methods including in vitro, in silico, and animal models of human toxicity. The course will then consider the design, conduct, interpretation, and analysis of clinical trials, including statistical, regulatory and ethical considerations. Pre: Graduate standing in the Master of Science in Biomedical Technology Development and Management Program.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BTDM 5244:
Biomedical Device Discovery and Development
This seminar course will cover a wide spectrum of devices from imaginig systems and integrated surgical platforms to health enterprise networks to microscale implantable devices. The course will focus on the technology and clinical impact of a device, along with the economic and regulatory processes involved in bringing a device from the research laboratory to the marketplace. Pre: STAT 5674 and graduate standing in Master of Science in Biomedical Technology Development and Management program.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BTDM 5254:
Drug Discovery and Product Development
This seminar course in drug discovery and development covers both therapy and diagnostics. It will focus on the scientific, clinical, economic and regulatory processes as well as stewardship involved in bringing a drug from the laboratory to the marketplace. Pre: STAT 5674 and graduate standing in Master of Science in Biomedical Technology Development and Management program.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

BTDM 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

BUILDING CONSTRUCTION

Walid Thabet, Head

Professors: Yvan Beliveau; Brian Kleiner; Jesus de la Garza;
Associate Professors: Michael Garvin; Thomas Mills; Sunil Sinha; Walid Thabet;
Assistant Professors: Ki-Hong Ku; Andrew McCoy; Annie Pearce; Georg Reichard; Deborah Young-Corbett;
Affiliated Faculty: Christine Fiori;
G.A. Synder-Falkinham Professor of Building Construction: Yvan Beliveau;
Vecellio Professor of Construction Engineering & Management: Jesus de la Garza;

Graduate Contact: renee.ryan@vt.edu
Building Construction: http://www.bc.vt.edu/degrees/graduates
Myers-Lawson School of Construction: http://www.mlsoc.vt.edu/

The program is open to students with various backgrounds to earn an MS degree in project and construction management with courses emphasizing various areas including planning and scheduling, estimating, 3D modeling and visualization, company management, building science, design-construction integration, sustainability, safety, and leadership. The program currently provides three options for completion: coursework only (with exit exam), Project and Report option, and Thesis option.

SPECIAL FACILITIES

The Department of Building Construction has just moved to Bishop-Favrao Hall; a new facility with labs. The labs will include a high-end Virtual Construction and Prototyping lab, a large workshop area equipped with small tools (for hands-on projects) and large equipment (for concrete mixing and experimenting); and a specialty workshop area (for individual faculty projects).

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (570.0)

Computer: (270.0)

iBT: (88.0)

1- Up to 19 credits of background and supporting courses - determination of total credits required depends on the individual student applying 2- 30 credit hours of required courses including 15 credits of core courses (common to all students

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BC 5044:

International Construction Practices

This course contrasts aspects of the US construction industry with similar yet fundamentally different operating procedures utilized within the international construction community. Areas of concentration include participant organization and culture, project delivery methods, multi-national teams and unique operational and management activities essential in the international market. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

BC 5124:

Land Development for Constructed Facilities

This course covers how to get a piece of undeveloped Real-estate from idea to the finished product. It discusses the construction management interface between Site Engineering and Real-estate Marketing. Topics covered include: market influences, working with regulatory agencies, zoning, economic considerations, developing an optimum plan, cost and schedule, engineering requirements, environmental impact, financing, and delivering a final product. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

BC 5184:

Temporary Structures

Introduction to the analysis, design, and selection of various temporary support structures needed in construction of building projects. Topics covered include excavation and temporary support methods, underpinning methods, dewatering systems, concrete formwork systems: selection, analysis/design, and construction. Due consideration is given to unconventional construction methods and placement techniques. Pre: senior status and instructor's approval or graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

BC 5304:

Principles of Construction Law and Project Delivery Systems

The course deals with the numerous ways in which the legal system affects or controls the construction process. Course topics include contract law, the relationships between the parties to the construction process, tort and negligence law, and statutory principles affecting construction. The major emphasis is on the principal contract relationships (Owner-Contractor, Contractor-Subconstractor, Owner-Architect/Engineer), and the problems and disputes that most typically arise out of these relationships. The course also explores innovations in project delivery systems such as design-build and CM at-risk. Graduate standing is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

BC 5354:

Integration of Design, Construction, and Manufacturing I

Introduction to the principles of integrated design, construction, and manufacturing, and design development process within advanced digital environments, construction automation and Building Information Modeling (BIM). Parametric modeling, assembly modeling, interference checking, rule-based design, within the context of advanced solid and surface modeling tools. Resource charges required. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

BC 5364:

Integration of Design, Construction, and Manufacturing II

The principles of integrated design, construction, and manufacturing for construction automation. Introduction to the fundamentals of CAD/CAM, real-time data capturing, and robotics. Overview of computer-numerically-controlled machines, basic manufacturing processes and prototyping techniques. Case study specifics in design, construction, and manufacturing. Resource charges required. Graduate standing required.
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

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

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

BC 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

BC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BC 6014:

Project and Company Management

Study of the management of a construction project and a construction company. Project management includes finances, cash flows, cost control, project organization, and project planning. Company management includes company organization incorporation structure, procedures, finance, insurances, accounting, and operation. Case studies are emphasized. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

BC 6064:

Research Seminar: Past, Present, and Future of Construction

This course will look at an historical perspective of construction and how the Architecture, Engineering, and Construction (AEC) industry has evolved to where it is today. The course will look at the key elements that have affected these changes, including the evolutionary/evolving roles of the participants of the entire AEC industry. Topics will include the means, methods and contracts from 1945 to today. Topics of discussion will include: risk, contracts, project & production management, labor, leadership, automation, industrialization and IT.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BUSINESS ADMINISTRATION

Richard Sorensen, Head

General Contact: mba_info@vt.edu

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

The Pamplin College of Business offers the Master of Business Administration (M.B.A.) degree. The college also offers the master of accounting and information systems, and the master of science in hospitality and tourism management. In addition, the doctor of philosophy (Ph.D.) in business administration is offered through the departments of Accounting and Information Systems; Business Information Technology; Finance, Insurance, and Business Law; Management; and Marketing. The Department of Hospitality and Tourism Management offers the doctor of philosophy in Hospitality and Tourism Management. Departments also offer the master of science (M.S.) in business administration in their specialties on a limited basis. Information specific to graduate degrees other than the M.B.A. is located under the associated department. Graduate degree programs offered by the Pamplin College of Business are fully accredited by the Association to Advance Collegiate Schools of Business (AACSB International) with the exception of the M.S. and Ph.D. in Hospitality and Tourism Management. Master of Business AdministrationThe plan of study leading to the Master of Business Administration is a 50-credit program requiring a bachelor of Science or Bachelor of Arts degree from an accredited college or university. All students must have a personal computer and keep its hardware and software up-to-date during the program. Full-time students need wireless laptop computers. The College of Business publishes minimum computer hardware and software standards each year.The M.B.A. is available at the Blacksburg campus, as well as at the Northern Virginia Center (through both executive and part-time program formats), and in Richmond/Roanoke through the Professional MBA program. Full-time students usually attend classes at the Blacksburg location and enroll in 12 to 16 credits per semester. Classes at the other locations are arranged to accommodate the needs of the working professional. The full-time program is cohort based; new students are only admitted fall semesters and generally take the same courses for the first two semesters of the program.

SPECIAL FACILITIES

Pamplin Hall

Academics and laboratories; west section completed 1952; dedicated Oct. 24, 1953. Cost $884,070. East section completed Fall 1959; cost $889,944. Building contains 165,918 sq. ft.

DEGREES OFFERED

MBA Degree

Offered In (Roanoke, National Capital Region, Blacksburg, Richmond)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

All applicants, regardless of status or campus location, must submit the following: a completed application, official college transcripts, official Graduate Management Admission Test (GMAT) score, a professional resume, and the appropriate application fee. Persons desiring to attend any location except the Northern Virginia Center part-time program should send these materials to the Virginia Tech Graduate School in Blacksburg. Applicants wishing to attend the Northern Virginia Center should send materials directly to that center. Detailed information about current admission and program requirements (which are subject to change) are available from the M.B.A. web site www.mba.vt.edu and at the M.B.A. and International Programs Office in the Pamplin College of Business. International applicants are also required to submit TOEFL scores. The minimum standards for admission conform to the university requirements, however, applicants with scores below 100 IBT or 26 on either the speaking or listening dimensions will be required to complete an English language course at the Virginia Tech language institute prior to beginning classwork. Please see the MBA program website for more information.The full-time M.B.A. requires 50 semester hours of course work and is structured so that students take only core courses during the first half of the program. The following courses are required: Management of Information Systems or Computer-Based DSS; Analytical Framework for Business Managers; Dynamics of Organization Behavior; Managerial Statistics; Fundamentals of Accounting; Operations Management; Principles of Finance; Ethical Dimensions of Leadership; and Marketing Policy and Strategy. The second half of the program consists of concentration courses, electives, including an international elective, and the capstone core course, Strategic Management.In addition, full-time students must complete two one-credit career-management courses. Full-time students cannot exempt core courses or transfer credit for core courses to Pamplin from another institution. In addition to the M.B.A. core, students take elective courses that may lead to an area of specialization called a concentration. The following concentrations are available: Corporate Financial Management; Investment and Financial Services Management; Organizational Management and Strategy; General Management; Marketing.

BUSINESS INFORMATION TECHNOLOGY

Bernard Taylor, Head

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

Associate Professors: Barbara Hoopes; Tabitha James; Raymond Major; Lance Matheson; Quinton Nottingham; Christopher Zobel;

Assistant Professors: Alan Abrahams; Jason Deane; Lara Khansa; Byung Kim; Onur Seref; Gang Wang;

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;

Graduate Contact: cliff.ragsdale@vt.edu

Student Handbook: http://bit.pamplin.vt.edu/graduate_programs.html

The doctorate offered through the Department of Business Information Technology is a full-time, four-year, residential program offering specializations in information technology/decision support systems and operations and supply chain management. Although the program emphasizes the study of technologies used in the creation, storage, exchange, and use of information in its various forms, considerable emphasis is also placed on the related disciplines of mathematical programming, stochastic processes, computer simulation, and statistics. Study of these topics requires that the student have a strong quantitative background. 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

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GMAT

: Verbal, Quantitative, Total

GRE

General: Verbal, Quantitative, Analytical

Responsibility for the administration of the doctoral program is shared by the Department of Business Information Technology and the university's Graduate School. General university graduate degree requirements, procedures, and policies, are available through the Graduate School's web site http://www.grads.vt.edu/. Applicants to the Ph.D. program in Business Information Technology must complete and submit scores for either the GMAT or GRE exam. 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. Full instructional responsibility for a least one course during doctoral studies. 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:

Management Science

Study of selected topics in management science as they apply to managerial decision making. Topics include resource allocation using linear programming, transportation and assignment models, network models for planning and scheduling, queueing models for waiting line analysis, and an introduction to simulation modeling and analysis. Use of the computer for problem analysis and solution is emphasized. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BIT 5414:

Production and Operations Management in A Global Environment

Analysis of the role of operations management in modern organizations. Emphasis will be placed on the interaction of production and operations management with other functional systems in an organization. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BIT 5454:

Distributed Processing and Data Communications

This course surveys the field of computer networking and communications. Students will learn reasons for networking as well as the costs and potential problems. In addition to computers, the course discusses hardware for local and wide area connectivity and other specialized devices. Software coverage includes operating systems, network management tools, drivers and protocols. Students will learn the primary duties of a network administrator in the operation of a computer network and become familiar with network planning, implementation, and routine administration. Pre: MBA students only or instructor's consent. I,II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BIT 5464:

Object Oriented Programming for Business

This course introduces concepts of object oriented programming (OOP). Comparisons between competing systems will be discussed. Emphasis will be placed on the practical application of object oriented concepts to business programming problems. Use of an object-oriented language will be required. Graduate standing and competence in a high-level programming language. MBA students only or instructor's consent. I,II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

BIT 5495:

Foundations of Decision Support Systems

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

BIT 5564:

Artificial Intelligence Applications in Business

Study of key artificial intelligence techniques and their role in decision making in a business context. Topics will include methodologies for the representation of knowledge, algorithms for intelligent search, and techniques for display of expert decisions. Primary emphasis is on rule-based or expert systems, neural networks, fuzzy logic concepts, and genetic algorithms.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BIT 5574:

Design Strategies for e-Business Systems

This course focuses on the strategic business analysis and design requirements of an e-Business System. This course focuses on the design of the marketing, knowledge, and transaction processing components of a typical e-business system. The course develops skills required in doing requirements analysis for e-businesses, understanding business processes required for e-businesses, and designing effective e-business architectures. Emphasis is placed on the application of object-oriented systems design, suitable analysis and design concepts from structured analysis, business process reengineering, and design of web-enabled client-server systems. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BIT 5594 (ACIS 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

BIT 5604:

Mod Decis Mkng for Comp Advntg

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

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

BIT 5634:

E-Business Innovation and Implementation

This course focuses on the strategic business analysis and key technologies that provide the foundation for e-business innovation and implementation. The course focuses on the technology that underlies the Internet and how firms compete and win in the information technology age. Emphasis is places on concepts, frameworks, and approaches that enable a corporate manager to embrace the Internet technology and to conduct online business. In addition to the study of the web and Internet, other topics such as formulating e-business strategy, e-business models, customer interface, and business-to-business marketplaces will be covered. Executive MBA students only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

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

BIT 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

BIT 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BIT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

BIT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

BIT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

BIT 6414:

Current Topics in Management Science

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

BIT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

CHEMICAL ENGINEERING

John Walz, Head

Professors: Luke Achenie; Donald Baird; David Cox; Richey Davis; William Ducker; Erdogan Kiran; Yih-An Liu; Eva Marand; Shigeo Oyama; John Walz;

Associate Professors: Aaron Goldstein; Chang Lu;

Assistant Professors: Stephen Martin; Padmavathy Rajagopalan; Abby Whittington;

Alexander F. Giacco Professor: Donald Baird;

Frank C. Vilbrandt Professor: Yih-An Liu;

Professor and Dept. Head: John Walz;

Univ. Distinguished Professor Emeritus: Garth Wilkes;

Emeritus Faculty: Garth Wilkes;

Graduate Coordinator: dianec@vt.edu

Graduate Chair: wducker@vt.edu

Department Head: jywalz@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 science and engineering, colloid and surface chemistry, solid state chemistry and physics, microelectronics and nanotechnology, applied thermodynamics, molecular modeling, biochemical and tissue engineering, 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

Colloidal Dispersions Lab

This lab is focused on measuring the physical properties of dispersions of colloidal particles in liquids. State-of-the-art instruments are available for measuring rheology, zeta potential, particle size distribution, and streaming potential.

Environmental Catalysis and Nanomaterials Laboratory

Research is being carried out in two major fields, membranes and catalysis. In the membrane area, work is being carried out in the discovery of new inorganic membranes for H2O and CO2 separations, their characterization with advanced tools, and their application in reactors that combine reaction and separation or delivery. In the catalysis area efforts are directed in the development of new compositions for biomass conversion and the understanding of their function at the molecular level using in situ methods.

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.

Membrane Characterization Lab

The research focus is on the development and characterization of new membrane materials for gas separations and water desalination and purification. Gas separations include natural gas, air and hydrocarbon separations.

Microfluidics Lab

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

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.

Prediction and Measurement of Surface Forces Lab

Surface Chemistry and Engineering.This lab is dedicated to discovering and altering the properties of solid-liquid interfaces, including wetting, adsorption, and the stability of colloidal dispersions. A significant component of the research is in the measurement and understanding of both equilibrium forces and viscous forces that occur on small particles in water and air.

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 C. 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.

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 (non-thesis) - Total of 30 credit hours. minimum of 24 graded credit hours all 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 maximum of 6 credits of 4000-level undergraduate course work maximum of 6 credit hours of Project & Report (5904)

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 all 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 maximum of 6 credits of 4000-level undergraduate course work 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 all 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 maximum of 6 credits of 4000-level undergraduate course work 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

CHE 5064:

Solids & Solid Surfaces

Introduction to the theory of solids. Physical properties of bulk crystalline solids and their surfaces are discussed. Excitations accompanying the interaction of electrons and photons with solids are discussed to provide

a basis for understanding a variety of experimental methods used in the characterization of solids. Methods for characterizing geometric and electronic structure are surveyed with an emphasis on techniques of ultrahigh-vacuum surface science.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CHE 5084:
Heterogeneous Catalysis
Fundamental aspects of heterogeneous catalysis; absorption, surface reactions, and catalyst preparation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

CHE 5164:
Process Dynamics and Simulation
Advanced techniques for modeling and simulation of chemical processing systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CHE 5214 (PSCI 6224) (GIA 6224) (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

CHE 5304 (BMES 5304) (PPWS 5304) (BIOL 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

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

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

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

CHE 5904:

Project and Report

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

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

CHE 5974:

Independent Study

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

CHE 5984:

Special Study

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

CHE 5994:

Research and Thesis

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

CHE 7994:

Research and Dissertation

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

CHEMISTRY

James Tanko, Chair

Professors: Karen Brewer; Paul Carlier; Daniel Crawford; Harry Dorn; Felicia Etzkorn; Richard Gandour; Harry Gibson; Brian Hanson; David Kingston; Timothy Long; Herve Marand; James McGrath; Joseph Merola; Robert Moore; John Morris; Judy Riffle; James Tanko; Sam Turner;

Associate Professors: Paul Deck; Alan Esker; Gary Long; Theresa Reineke; Brian Tissue; Diego Troya; Gordon Yee;

Assistant Professors: Louis Madsen; Webster Santos; Eduard Valeyev; Sungsool Wi;

University Distinguished Professor: David Kingston;

University Distinguished Professor and Ethyl Corporation Chair: James McGrath;

Emeritus Faculty: Henry Bauer; Harold Bell; Neal Castagnoli; Raymond Dessy; James Glanville; David Larsen; Harold McNair; Michael Ogliaruso; George Sanzone; John Schug; Larry Taylor; Jimmy Viers; Thomas Ward; James Wightman; James Wolfe;

Graduate Contact: millera@vt.edu

Graduate Program Director: pdeck@vt.edu

Graduate Admissions Director: gandour@vt.edu

Graduate Site: http://www.chem.vt.edu/grad/index.html

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

Admissions: http://www.chem.vt.edu/grad/grad-admissions.html

The Chemistry Department presently ranks in the Top 40 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. All major areas of chemistry (analytical, inorganic, organic, and physical) are represented in our research programs, and in addition, our polymer chemistry program is ranked among the Top 5.

SPECIAL FACILITIES

The Chemistry Department is housed in three adjoining buildings. Davidson Hall is the original chemistry building, featuring both classrooms and research laboratories. Hahn Hall is exclusively devoted to research, and the building features a lovely atrium gathering space. The Chemistry Physics building 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) and the Virginia Tech Corporate Research Center (CRC).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, three 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, and pulsed-field gradients) are available.

College of Science -- Crystallography Laboratory

Our X-ray diffractometer is housed in the College of Science crystallography laboratory (VTX), which features five diffractometers and a range of capabilities such as ultra-low temperature (to 15 K), high pressure (to 10 GPa), proteins, and high-throughput crystal-screening equipment.

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: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

This section offers brief synopses of the programmatic requirements for the MS and PhD 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: http://www.chem.vt.edu/grad/grad-documents/grad-orange-book.pdfThe MS 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 MS option that is based exclusively on course-work. The Thesis MS degree requires 20 credit hours of graduate course work, the presentation of one seminar, and the preparation and oral defense of the MS thesis. The non-thesis MS 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: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

This section offers brief synopses of the programmatic requirements for the MS and PhD 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: http://www.chem.vt.edu/grad/grad-documents/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 interest area and is 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 pass three oral exams (preliminary, third-year, and final).

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

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

CHEM 5084 (BMVS 5084) (FST 5084):
Macromolecular Interfaces with Life Sciences Seminar
Experience in developing and presenting a technical seminar related to oxidative processes at the macromolecule-biomolecule inteface. Tours and presentations at research facilities at regional industrial sites. Idea generation for the purpose of resolving technical questions and advancing research projects. 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): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

CHEM 5094 (PSCI 5564) (GIA 5564) (FST 5094) (WS 5564) (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. (3H, 3C) Graduate standing required. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CHEM 5104:
Advanced Analytical Chemistry I
Discussion of theory and applications of separations and spectrometry in analytical chemistry. Topics include; GC, HPLC, Gel Permeation Chromatography, Electrophoresis, AAS, AES, AFS, lasers, flame, and plasma diagnostics. One year of physical chemistry required. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

CHEM 5174 (PSCI 5214) (ESM 5174) (GIA 5214):
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

CHEM 5384 (FST 5384) (HNFE 5724) (BMVS 5384) (PHS 5024):

Oxidation at the Interface of Chemistry and Biology

An advanced survey of the chemistry and biochemistry associated with oxidation reactions and the relationship to positive and detrimental outcomes in synthetic and natural macromolecules and biological systems. Topics include free radical chemistry, reactive oxygen and nitrogen species in living systems, enzyme-catalyzed oxidations, oxidation of foods and materials, oxidative stress and health effects, chemistry of antioxidants. 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

CHEM 5424 (GIA 5444) (PSCI 5444) (WOOD 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

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

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

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

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

CHEM 5526 (GEOS 5536):

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

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

CHEM 5536:

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

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

CHEM 5654:

Adhesion Science

Introduction to basic principles of adhesion science from the areas of mechanics, materials, and chemistry. Consent required. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

CHEM 5884:

Macromolecular Chemistry at the Biology Interface Laboratory

An advanced laboratory course that involves state-of-the art experimental techniques with applications for data interpretation and presentation for future professionals at the polymer chemistry-biology interface. Team-oriented experiments will use traditional and emerging polymer chemistry techniques and applied biological methods, specifically those involving analysis of free radical and oxidative processes. PRE: CHEM/FST/BMVS 5384 or simultaneous enrollment in this course.

Credit Hour(s): 0 OR 2

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

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

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

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

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

CHEM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

CHEM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

CHEM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

CHEM 6434:

Organometallic Chemistry

Chemistry and applications of organometallic and related compounds.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

CHEM 6904:
Generating Research Ideas
Process of generating and evaluating novel research ideas in chemistry. P/F only Pre-requsite: Graduate Standing
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

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

CHEM 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

CHEM 7994:
Research and Dissertation
Credit Hour(s): 1 TO 20
Lecture Hour(s):
Instruction Type(s): Research

CIVIL ENGINEERING

William Easterling, Head

Professors: Gregory Boardman; Thomas Cousins; William Cox; Andrea Dietrich; Thomas Dingus; Panayiotis Diplas; William Easterling; Marc Edwards; George Filz; Gerardo Flintsch; Adil Godrej; Thomas Grizzard; Antoine Hobeika; Shinya Kikuchi; William Knocke; John Little; James Martin; Glenn Moglen; John Novak; Hesham Rakha; Elisa Sotelino; Antonio Trani; Linbing Wang; Richard Weyers; Mark Widdowson; Jesus de la Garza;
Associate Professors: Thomas Brandon; Finley Charney; Randel Dymond; Daniel Gallagher; Michael Garvin; Russell Green; Kathleen Hancock; Linsey Marr; Matthew Mauldon; Amy Pruden-Bagchi; Carin Roberts-Wollmann; Adrian Rodriguez-Marek; Kamal Rojiani; Sunil Sinha; Peter Vikesland; William Wright;
Assistant Professors: Montasir Abbas; Matthew Eatherton; Mani Golparvar-Fard; Erich Hester; Cristopher Moen; Pamela Murray-Tuite; Deborah Young-Corbett;
Research Faculty: Joseph Dove;
Vecellio Professor: Jesus de la Garza;
Newport News Shipbuilding/Tenneco: Thomas Dingus;
Emeritus Faculty: J Duncan; Don Garst; Siegfried Holzer; David Kibler; James Mitchell; Thomas Murray; Raymond Plaut; Clifford Randall; Dusan Teodorovic; Michael Vorster;
Montague-Betts: William Easterling;
Charles P. Lunsford: Marc Edwards;
Charles E. Via, Jr.: George Filz; Shinya Kikuchi;
W. Curtis English: William Knocke;
Nick Prillaman Professor: John Novak;
David H. Burrows Professor: Michael Vorster;
Charles E. Via, Jr. Professor: Richard Weyers;

Graduate Contact: lindycra@vt.edu
General Contact: bwingate@vt.edu
General Contact: jeny15@vt.edu
Student Handbook: http://www.cee.vt.edu/docs/File/gradpolicy.pdf
Graduate Site:
http://www.cee.vt.edu/index.php?content=10&apps=0&level=3&id=6

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 80 to 100 MS degrees, and between 13 and 18 Ph.D. degrees. The graduate enrollment of approximately 280 to 315 is one of the largest in the Southeast. The Department routinely ranks in the top 12-13 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 48 full-time faculty, including three members of the National Academy of Engineering, one member of the National Academy of Science, and nine additional faculty members who have been awarded prestigious named professorships. Eleven members of the faculty have been awarded Presidential Young Investigator, National Young Investigator, or CAREER awards from the National Science Foundation. Faculty within the department have received numerous national and regional awards in relation to 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 $13 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. Approximately 125 students pursue graduate degree programs through these programs each year. 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

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

TOEFL

Paper: (570.0)

Computer: (230.0)

iBT: (88.0)

GRE

General Test: Verbal, Quantitative, Analytical

See Departmental Manual at
http://www.cee.vt.edu/docs/File/gradpolicy.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)

Computer: (230.0)

iBT: (88.0)

GRE

General Test: Verbal, Quantitative, Analytical

See Departmental Manual at
http://www.cee.vt.edu/docs/File/gradpolicy.pdf

PhD Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (570.0)

Computer: (230.0)

iBT: (88.0)

GRE

General Test: Verbal, Quantitative, Analytical

See Departmental Manual at
http://www.cee.vt.edu/docs/File/gradpolicy.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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

CEE 5034:

Construction Systems Design and Integration

This course will study building systems, their design and how to best manage the life cycle cost of the systems. The course will have particular emphasis on systems. The course will have particular emphasis on mechanical and electrical equipment in buildings, solar design, lighting design, site orientation, value engineering and constructability of the various systems. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5040:

Design of Construction Operations

Design and analysis of construction operations using discrete-event simulation modeling. Modeling construction operations using activity cycle diagrams. Collection and reduction of construction data. Selection of distribution models and estimation of parameters. Goodness of fit testing. Assessment of independence and autocorrelation. Design of simulation experiments. Output analysis and confidence intervals of performance measures. Variance reduction techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5044:

Construction Research Presentation

This course requires that students produce a written paper and make an oral presentation based on a construction research topic of their choice. It is designed to sharpen skills in the written and oral presentation of technical material. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5050:

Construction Decisions Under Uncertainty

Construction project and organization decisions for the uncertain future. Selection of construction methods, equipment, project and operation attack strategies, contract, markup, and financing alternatives having the highest expected values and utilities. Use of decision and utility theory, competitive bid analysis, and probabilistic modeling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5054:

Construction Performance Improvement

Skills for productivity improvement in construction, with special attention to techniques used to record and analyze operations as required to develop and implement efficient and rewarding methods. Consideration of the human factor in generating and implementing commitments to productivity improvements. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5070:

Equipment Economics and Applications

Methodologies for determining the owning and operating cost and economic life of construction equipment. Application of engineering economics to equipment management decisions with particular reference to maintain, rebuild, replace decisions. Techniques to analyze equipment intensive operations, determine actual and delay free cycle times, match individual units and balance fleets. Synthesis of knowledge regarding production and cost to optimize productivity and reduce unit costs.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

CEE 5084:

Information Technology in the Construction Industry

Information technology concepts, computer technology, analyses and design of applications as well as means and concepts to guide development, implementation, and transfer of information system applications in the Architecture/Engineering/Construction (AEC) and

Engineering/Procurement/Construction Industries.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CEE 5130G:

Indoor Environ Qual Sustain

Indoor environmental quality factors and associated sustainable design methods and approaches. Air containinant sources, emission and dispersion patterns, health impacts, and control solutions. Methods of improving IEQ through material and ventilation solutions. Applicable regulatory requirements and sustainability organization recommendations will be reviewed. Pre-requisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5134:

Engineering Aspects of Water Quality

The application of biological, chemical, and physical principles of water quality to engineering problems in surface waters.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CEE 5154:

Air Pollution Control Engineering

Principles and practice of air pollution source control with emphasis on stationary source control and equipment operating and design parameters; economic and technical evaluation of control system design alternatives.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5174:

Industrial and Hazardous Wastes Control

Contemporary methods for the management and treatment of industrial wastewaters, including in-plant reductions and reuse. Characterization and management of hazardous wastes. Design of appropriate systems. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5244 (BMES 5514) (BSE 5244) (ME 5714):

Advanced GIS in Hydrologic Analysis

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

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

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

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5354:

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5404:

Plate and Shell Structures

Classical solutions of elastic plate theory; approximate methods; continuous plates; orthotropic plates. Theory of thin shells of revolution; membrane and bending actions.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5444:

Dynamic Stability of Structures

Modern structural stability analysis; static and dynamic instability; conservative and nonconservative systems; multiple loads; and Liapunov stability analysis. Applications to columns, rotating shafts, pipes conveying fluid, and airplane panels. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5454 (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

CEE 5464 (ESM 5464) (PSCI 5484) (GIA 5484):
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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5484:
Advanced Bridge Design
Relationship of bridges to national needs; illustration of a preliminary design by case history; design of conventional bridge decks and girders; curved box-girder bridges; segmental construction; cable-stayed bridges; importance of design details on the seismic resistance of bridges.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CEE 5494G:
Intermediate Computer Methods on Structural Design
Design of structural members in steel, concrete, and wood using computers. Computer-aided design of structural systems. Development of computer programs for the solution of structural design projects. Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5630:
Design and Operation of Advanced Public Transportation Systems
An overview of the use of intelligent transportation systems (ITS), technologies and user services in design and operation of advanced public transit systems (APTS); emphasis is placed on communication, sensor application, information processing, traffic control, en-route and pre-trip information, electronic payment, and fleet management as they pertain to transit and paratransit services in large metropolitan areas as well as in small urban and rural communities.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5660:
Trans Risk, Reliab & Security
Transportation risk assessment and computation; evacuation modeling; reliability analysis; infrastructure interdependency analysis; network impact assessment. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5670:
Applied Traffic Engr Analysis
Definition of traffic engineering and theory of traffic engineering. Evaluation and identification of traffic engineering problems and development of solutions. Application of theory to real-world problems using intersection design and control, analysis of capacity and level of service for freeways and arterials, traffic signal design and potimization, geometric design, highway and intersection simulation. Pre-requisite: Graduate Standing
Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

CEE 5704:

Environmental Chemistry Laboratory

Laboratory course in support of 5104, Environmental Chemistry, allowing students to perform experiments related to natural environmental processes, including biological oxygen consumption, complexation, and carbonate equilibria. Consideration of laboratory procedures used to investigate and assess environmentally related materials and their contaminants.

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab

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

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

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

CEE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

CEE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

CEE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

CEE 6014:

Project and Company Management

Study of the management of a construction project and a construction company. Project management includes finances, cash flows, cost control, project organization, and project planning. Company management includes company organization incorporation structure, procedures, finance, insurances, accounting, and operation. Case studies are emphasized. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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. II
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CEE 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

CEE 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

COMMUNICATION

Robert Denton, Head

Professors: Robert Denton; William Hopkins; Samuel Riley;
Associate Professors: Rachel Holloway; John Tedesco; Beth Waggenspack;
Assistant Professors: Yi Chun Chen; James Ivory; Jim Kuypers; Jennifer Mackay; Robert Magee; Damion Waymer;
W. Thomas Rice Chair: Robert Denton;
Emeritus Faculty: Edward Sewell;

Graduate Contact: comm@vt.edu
Department of Communication: http://www.comm.vt.edu/

The Master of Arts in Communication program at Virginia Tech provides its students with conceptual knowledge and advanced skills that they can apply to academic and professional communication settings. The curriculum and degree requirements offer students advanced study in public and mass communication research from a variety of theoretical and methodological perspectives. Students in the 33 hour, two year program engage in reviewing and discussing previous communication research and criticism, collecting and interpreting original communication research data, synthesizing and presenting communication knowledge to educate others, and obtaining professional experience in the communication industry. Areas of conceptual focus include the production, content, and impact of communication messages, media, artifacts, and objects within social, political, organizational, and cultural settings. The M.A. in Communication prepares graduates to pursue communication doctoral studies, research positions in communication industries, advanced teaching careers, and advanced careers as communication professionals.

SPECIAL FACILITIES
The Department of Communication has a research lab with several experimental and observation rooms. 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 (e.g., PS2, Xbox360, Nintendo Wii, PS3), multiple presentation systems, networked laptop computer system, and two dedicated internal wireless servers. Graduate students may also benefit from our media production equipment.

Communication research facility

The Department of Communication has a research lab with several experimental and observation rooms. 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 (e.g., PS2, Xbox360, Nintendo Wii, PS3), multiple presentation systems, networked laptop computer system, and two dedicated internal wireless servers. Graduate students may also benefit from our media production equipment.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

All graduate students receiving the M.A. degree in Communication must complete 33 credit hours. Each student must take 9 hours of core subjects (Communication Theory, Communication Research Methods, and Rhetorical Theory & Criticism), 3 hours of electives, and between 15 and 18 hours of Communication coursework. Options to complete the MA degree include a thesis (6 hours) or an internship (3 hours). In addition, each graduate student must pass a final examination administered by the student's advisory committee. The final exam in the thesis option is defined as receiving a pass of the oral defense of the thesis. The final exam in the non-thesis option (internship) is defined as receiving a pass of the written and oral comprehensive exam.

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

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

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

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

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

COMM 5544:

Mass Media and US Politics

This course explores the role of the mass media in contemporary American politics by examining the development of the media as sources of social and political influence in twentieth century America; how the mass media cover electoral and issue campaigns; the impact such coverage has had on candidates and their campaign strategies and on the behaviors of voters. Various perspectives on what the future may hold for American politics.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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. Pass/Fail only.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

COMM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

COMM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

COMM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

COMPUTER ENGINEERING

Scott Midkiff, Head

Professors: Peter Athanas; Aloysius Beex; Dushan Boroyevich; Tamal Bose; Robert Broadwater; Gary Brown; C Clauer; William Davis; Dong Ha; Michael Hsiao; Mark Jones; Jih Lai; Fred Lee; Paolo Mattavelli; Scott Midkiff; Lamine Mili; Khai Ngo; Mariusz Orlowski; Paul Plassmann; Ting Chung Poon; Timothy Pratt; Saifur Rahman; Sanjay Raman; Krishnan Ramu; Jeffrey Reed; Sedki Riad; Ahmad Safaai-Jazi; Wayne Scales; William Tranter; Joseph Tront; Yue Wang; Anbo Wang;

Associate Professors: Amos Abbott; Masoud Agah; Scott Bailey; William Baumann; Richard Buehrer; Virgilio Centeno; Jaime De La Reelopez; Steven Ellingson; Louis Guido; Yiwei Hou; Mantu Hudait; Douglas Lindner; Allen MacKenzie; Thomas Martin; Kathleen Meehan; Willem Odendaal; Jung-Min Park; Cameron Patterson; JoAnn Paul; Binoy Ravindran; John Ruohoniemi; Sandeep Shukla; Luiz Silva; Daniel Stilwell; Kwa Sur Tam; Chris Wyatt; Jianhua Xuan;

Assistant Professors: Joseph Baker; Majid Manteghi; Leyla Nazhandali; Patrick Schaumont; Christopher White; Yong Xu; Yaling Yang; Claudio da Silva;

Bradley Distinguished Professor of Electromagnetics: Gary Brown;

Hugh P and Ethel C Kelly Professor: James Thorp;

Emeritus Faculty: James Armstrong; Ioannis Besieris; Charles Bostian; Richard Conners; Walling Cyre; David De Wolf; Festus Gray; Richard Moose; Charles Nunnally; Arun Phadke; Frederick Stephenson; Warren Stutzman; James Thorp; Hugh Vanlandingham;

Alumni Distinguished Professor: Charles Bostian;

Bradley Professor of Communications: William Tranter;

Willis Worcester Professor: Jeffrey Reed;

University Distinguished Professor: Fred Lee; Arun Phadke;

Clayton Ayre Professor: Anbo Wang;

American Electric Power Professor: Dushan Boroyevich;

Joseph R. Loring Professor: Saifur Rahman;

Thomas L. Phillips Professor: Warren Stutzman;

Graduate Admissions: vt.ece.gradadm@vt.edu

Graduate Counseling: vt.ece.gradadv@vt.edu

NCR Graduate Coordinator: cdrobi@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 525 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 very 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

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

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (96.0)

GRE

General Test: Verbal (500.0), Quantitative (725.0), 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.

Degree Concentrations:

Research Areas

The outstanding ECE faculty is world-renowned for teaching and research. Students can select an area of research from the following Computer Engineering areas available through the Bradley Department of Electrical and Computer Engineering: Computer Systems Networking Software and Machine Intelligence VLSI and Design Automation

MS Degree

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

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (96.0)

GRE

General Test: Verbal (500.0), Quantitative (725.0), Analytical (550.0)

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.

Degree Concentrations:

Research Areas

The outstanding ECE faculty is world-renowned for teaching and research. Students can select an area of research from the following Computer Engineering areas available through the Bradley Department of Electrical and Computer Engineering: Computer Systems Networking

Software and Machine Intelligence VLSI and Design Automation

PhD Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (96.0)

GRE

General Test: Verbal (500.0), Quantitative (725.0), Analytical (550.0)

IELTS

General: Band (7.5)

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.

Degree Concentrations:

Research Areas

The outstanding ECE faculty is world-renowned for teaching and research. Students can select an area of research from the following Computer Engineering areas available through the Bradley Department of Electrical and Computer Engineering: Computer Systems Networking Software and Machine Intelligence VLSI and Design Automation

GRADUATE COURSES (ECE)

ECE 5104:

RF & Microwave Engineering and Applications

A review of basic electromagnetics. Transmission lines, waveguides, microstrip lines, striplines. Microwave networks and impedance matching, Smith chart, S-Matrix, ABCD matrix, transformers. Microwave filters. Active RF components. Microwave amplifier design. Microwave systems. Microwave Integrated Circuits (MIC). RF Microelectromechanical System (MEMS) components. RF components for wireless systems. RF components for Ultra Wideband (UWB) systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 5105:

Electromagnetic Waves

Maxwell's electromagnetic field theory and its applications to engineering problems. 5105: Fundamental concepts associated with elementary plane wave theory and boundary value problems with applications to half-space reflection problems; fundamental theorems. 5106: Analytical techniques (Green's theory, modal analysis, integral equations, etc.) applied to setting up, approximating, and solving radiation, unguided, and guided wave propagation, and scattering by medium discontinuities in open and closed geometries. Graduate standing required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5106:

Electromagnetic Waves

Maxwell's electromagnetic field theory and its applications to engineering problems. 5105: Fundamental concepts associated with elementary plane wave theory and boundary value problems with applications to half-space reflection problems; fundamental theorems. 5106: Analytical techniques (Green's theory, modal analysis, integral equations, etc.) applied to setting up, approximating, and solving radiation, unguided, and guided wave propagation, and scattering by mdeium discontinuities in open and closed geometries. Graduate standing required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

ECE 5204:

Power Semiconductor Devices

Characteristics, fabrication and application of power semiconductor devices which includes BJT, FET, power diodes, insulated gate and static induction transistors. Device drive requirements and power circuit interaction. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 5206:

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

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

ECE 5214:

Phase-locked Loops: Theory and Practice

Fundamental theory and design concepts of frequency synchronization techniques. Emphasis is on phase-locked loops and applications in communications for frequency synthesis, tracking, and demodulation.

Laboratory investigates fundamental principles of operation with a final project to develop specific aspects of a loop in detail. Alternate year course.
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

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

ECE 5224:

Non-Linear Communication Circuits

Advanced methods of analysis and design of communication circuits with emphasis on nonlinear effects and filtering. Nonlinear device models and their use in the design of oscillators and mixers at HF through UHF frequencies. The design of power amplifiers. I. Alternate years.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5234:

Emi and Noise Reduction Techniques

Theory and practice of E.M. noise coupling; Techniques for noise reduction: shielding, grounding and filtering. Measurement of EMI to comply with government regulation. EMI problems and solutions to switching power supply applications. Design of EMI filter. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5235G:

ADV Electronic Packaging

Design issues such as electrical, electromagnetic, thermal, mechanical, and thermomechanical, are covered at the lower levels of packaging hierarchy. Materials and process selection guidelines are discussed for the manufacturing and reliability of chip carriers, multichip and hybrid modules. Theoretical bases for design methodology and package reliability. Solid modeling for electrical and thermal designs from chip to board. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5236G:

ADV Electronic Packaging

System-level package design issues to meet application requirements are introduced and modeling tools for analyzing electronic packages are applied. Materials and process selection guidelines are discussed for the manufacturing and reliability of packaged electronic products. Application of theoretical principles to analysis designs. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5240G:

Adv Semiconductor Proc Lab

Design, layout, fabricate, and characterize mircoeletronic devices. Analyze test results to verify performance to the predetermined specifications. Participate on a team project in which they will develop processes used to fabricate more advanced devices and/or circuits. Required oral and written reports. May not be taken if credit has been previously earned for ECE 4244.
Credit Hour(s): 3
Lecture Hour(s): 1
Instruction Type(s): Lab, Lecture

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

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

ECE 5260:

Power Electronics System Integration

A broad overview of advanced power electronics technologies with an emphasis on multi-disciplinary aspects of integrated design. Investigation of relationships between system application requirements and technological challenges in circuit topologies, power semiconductor devices, sensing and control, integrated packaging, and thermal management, and their impact on the system reliability and cost. Introduction to the concept of integrated power electronics modules and their application in distributed power systems and motor drives. The course is organized as a series of seminar lectures jointly taught by leading researchers from several universities and industry, via distance access. P/F only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

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

ECE 5364:

Electric Energy and Environmental Systems

Role of electricity from fossil and nuclear fuels, and renewable resources. Impact of high voltage transmission lines. Health effects of electricity generation. Assessment of cogeneration cycles and demand side management. Emission control in the US electric utility industry. Evaluation of uncertainties in quantifying emissions impacts. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

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

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

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

ECE 5524:

Pattern Recognition

Computational methods for the identification and classification of objects. Feature extraction, feature-space representation, distance and similarity measures, decision rules. Supervised and unsupervised learning. Statistical pattern recognition: multivariate random variables; Bayes and minimum-risk decision theory; probability of error; feature reduction and principal components analysis; parametric and nonparametric methods; clustering; hierarchical systems. Syntactic pattern recognition: review of automata and language theory; shape descriptors; syntactic recognition systems; grammatical inference and learning. Artifical neural networks as recognition systems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ECE 5544:

Coding Theory

Use of codes to improve the reliability of transmission over noisy channels. Algebraic structure of codes. Includes error detecting and correcting codes. BCH Codes, Reed Solomon Codes, and convolutional codes and codes for checking arithmetic operations. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 5546:

Advanced VLSI Design

Advanced concepts in CMOS-based digital system design 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 techniques in the different levels of the design hierarchy (5546) 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

ECE 5550G:

Advanced Real Time Systems

Introduction to real-time systems, real-time scheduling including multiprocessor scheduling, real-time operating systems (kernels), real-time communication, real-time programming languages, reliability and fault-tolerance, and real-time system requirements and design methods. Design, analysis, and implementation of real-time kernel mechanisms and real-time applications using kernels such as Linux and programming languages such as C (with POSIX primitives) and real-time Java. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5554:

The Theory and Design of Computer Vision Systems

Gives a critical examination of current theories of computer vision. Explores both image analysis and scene analysis methods with the emphasis being given to scene analysis techniques. Emphasis is placed on the strategies that can be used rather than upon particular operators. Gives the design trade-offs associated with the various strategies. Draws analogies between computer vision techniques and the operations that are seemingly performed in human vision.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5560 (CS 5560):

Network and Computer Security

Introduces both fundamental security principles as well as real-world applications of network and computer security. Covers a wide range of topics including authorization and access control, basic cryptography, authentication systems, e-commerce security, sensor network security, and legal and ethical issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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 is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

ECE 5566 (SOC 5214) (PAPA 5214) (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

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

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

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

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

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

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

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

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

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

ECE 5635:

Radar Systems Analysis and Design

5635: Theory and practice of radar systems used for detection, tracking, and location of targets. Covers measurement of range and velocity, pulse compression, design of radar transmitters, receivers, and antennas. 5636: Performance analysis of modern radar signal processing techniques. Topics include radar signal detection theory and optimal receiver analysis, target parameter estimation, pulse compression techniques, clutter reduction, and tracking. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5636:

Radar Systems Analysis and Design

5635: Theory and practice of radar systems used for detection, tracking, and location of targets. Covers measurement of range and velocity, pulse compression, design of radar transmitters, receivers, and antennas. 5636: Performance analysis of modern radar signal processing techniques. Topics include radar signal detection theory and optimal receiver analysis, target parameter estimation, pulse compression techniques, clutter reduction, and tracking. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

ECE 5655:

Communication System Design

5655: Physical concepts and practical topics providing tools to calculate carrier-to-noise ratio in communication systems are discussed, including: noise processes, polarization topics, atmospheric propagation, receiver components, antennas, system calculation, and case studies. 5656: Advanced topics in digital satellite communications are discussed. These include multiple access, digital modulation, error correction coding, carrier phase, and symbol timing recovery. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5656:

Communication System Design

5655: Physical concepts and practical topics providing tools to calculate carrier-to-noise ratio in communication systems are discussed, including: noise processes, polarization topics, atmospheric propagation, receiver components, antennas, system calculation, and case studies. 5656: Advanced topics in digital satellite communications are discussed. These include multiple access, digital modulation, error correction coding, carrier phase, and symbol timing recovery. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

ECE 5664:

Cellular Radio and Personal Communications

Fundamental theory and design of high capacity wireless communications systems. Topics include trunking, propagation, frequency reuse, modulation, coding, and equalization. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

ECE 5724:

Neural and Fuzzy Systems

Introduction to various structures of artificial neural networks and fuzzy logic systems, as well as special learning mechanisms such as generalized back-propagation, clustering and genetic algorithms. Applications will be made to classification problems, binary associative memories, self-organizing maps, and nonlinear system modeling and control including on-line adaptation. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5744 (ME 5544) (AOE 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

ECE 5754 (ME 5554) (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

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

ECE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

ECE 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ECE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ECE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

ECE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

ECE 6314:

Microcomputer Applications in Power Systems

Role of microcomputers in monitoring, control, and protection of power equipment and networks. Hierarchical computer systems. Protection algorithms. Protection of line, transformers, and buses with microcomputers. Real time phasor measurements. Measurement of frequency. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

ECE 6364:

Smart Grid Design & Operation

Introduction to smart grid technologies. Operating principles and models of smart grid components, including distributed energy sources and distribution feeder components. Communication infrastructure for smart grid operation. Advanced metering infrastructure and advanced control methods. Demand response and demand management. Distribution feeder analysis. Impact of smart grid component integration on distribution network operation. Smart grid reliability evaluation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 6444:

Advanced Topics in Controls

Advanced topics of current interest in control theory taken from current research topics or technical publications. Graduate standing required. May be repeated.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 6514:

Applications of Automata Theory to Digital Design

Applications of theory of finite automata, push-down automata, and Turing machines to the design of digital machines. Emphasis will be on the computational capabilities of classes of finite and infinite automata and on the consequences for digital design. Theory of NP-completeness, description of NP complete problems in digital design, and the consequences for design processes. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ECE 6624:

Spectral Estimation & Modeling

An advanced introduction to the processing and modeling of random discrete-time signals. Random time series, auto- and cross-correlation sequences and their generation, filtering of random sequences, Wiener filters, matched filters, modeling assumption errors, one-step predictors, rational modeling of random sequences, parametric and non- parametric spectral estimation. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ECE 6774 (AOE 6774) (BMVS 5454) (ME 6574) (VM 8034):
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

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

ECE 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

COMPUTER SCIENCE & APPLICATIONS

Barbara Ryder, Head

Professors: Osman Balci; Christopher Barrett; Ing Ray Chen; Edward Fox; Lenwood Heath; Dennis Kafura; Madhav Marathe; Francis Quek; Narendran Ramakrishnan; Elisa Sotelino; Layne Watson;
Associate Professors: James Arthur; Godmar Back; Douglas Bowman; Kirk Cameron; Stephen Edwards; Csaba Egyhazy; Weiguo Fan; Wu-Chun Feng; William Frakes; Denis Gracanin; Chang Tien Lu; Donald McCrickard; T Murali; Christopher North; Alexey Onufriev; Manuel Perez-Quinonez; Calvin Ribbens; Adrian Sandu; Joao Setubal; Clifford Shaffer; Deborah Tatar; Srinidhi Varadarajan; Liqing Zhang;
Assistant Professors: Ali Butt; Yang Cao; Yong Cao; Vicky Choi; Gregory Kulczycki; Eli Tilevich; Anil Vullikanti; Danfeng Yao;
Research Faculty: Joseph Gabbard; Steve Harrison; Deborah Hix; Andrea Kavanaugh;
Affiliated Faculty: Noah Barnette; William McQuain;
Emeritus Faculty: Roger Ehrich; Hillyard Hartson;
Research Professor: Andrea Kavanaugh;

Graduate Contact: gradprog@cs.vt.edu
Graduate Site: http://www.cs.vt.edu/graduate
Student Handbook: http://www.cs.vt.edu/files/GraduateCSHandbook.pdf

The graduate program at the Department of Computer Science at Virginia Tech is poised to become one of the top programs in the country. Recent accolades to the program include ranking as a top-30 program in the US (by number of Ph.D. degrees awarded) and as a "top 10 IT program to watch" by Computerworld.

SPECIAL FACILITIES
Laboratories in the Department of Computer Science in Blacksburg is 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 20 node Gig-E research cluster with 2 processors & 4GB of memory per node. Mnemosyne is a high memory workstation for intense memory usage calculations and is used by graduate and faculty researchers for large dataset manipulation. Kuprin is a new Dual NVidia Tesla GPU processor machine using nVidia GT200 [Tesla C1060] cards.
Center for High-End Computing Systems (CHECS)
System G: The System G cluster (above) 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 rapid growth of HCI research at Virginia Tech has resulted in several laboratories housed in the KWII building. Included are: o Ten 145 square foot project rooms, some with two-way observation windows;o A 280 square foot general HCI laboratory;o A 2,330 square foot shared laboratory space incorporating: The Aware Laboratory (directed by Francis Quek) containing extensive instrumentation for meeting participant tracking and gesture, voice and video analysis; The Gigapixel Display Laboratory (directed by Christopher L North) containing several large, high-resolution displays; The Virtual and Augmented Reality Laboratory (directed by Denis Gracanin) containing immersive displays and tracking systems; The 3D Interaction Laboratory (directed by Doug Bowman) containing a wide variety of 3D and advanced input devices, as well as virtual environment display technology; and Extensive conference and meeting facilities.The CHCI core laboratories are co-located so that equipment from any laboratory is readily available for use in another laboratory. The space in KWII brings together facilities that previously could not be spatially co-located due to the rapid expansion of HCI research at Virginia Tech. Below are descriptions of the CHCI core laboratories.Aware Laboratory: The Aware Laboratory provides space and infrastructure for research in human multimodal interaction, computer vision, and multimedia data access. The space features a 1,100 sq ft aware meeting room. A suite of 10 genlocked and pair-wise calibrated cameras (recording into digital disks) and a Vicon near-infrared motion capture system featuring 8 highspeed, high-resolution cameras capture the visual behavior of meeting participants. A set of eight close-talking Countryman microphones with wireless transmitter/receivers and a pair of desktop microphones capture synchronized audio into a digital audio recorder. All video, motion-capture, and audio devices are genlocked to a single black-burst generator. A suite of Macintosh G5 computers provide the computation and video handling.Gigapixel Display Laboratory: The Gigapixel Display Laboratory provides infrastructure for research using large-scale, high-resolution, and reconfigurable displays. Currently two display technologies are being utilized: tiled LCD panels and stackable rearprojection blocks. The largest tiled LCD display features fifty 17-inch panels with thin bezels, each capable of displaying 1600x1200 pixels, for a total of more than 100 million pixels. The panels are attached to columns, and each column can be moved or rotated, allowing the display to be reconfigured in various form factors (flat, curved, angled, etc.). Twenty-five ?shuttle? PCs drive two displays each, with a head node coordinating rendering. The facility also includes various smaller tiled LCD prototypes, including several that are used routinely for individuals?

daily work. The rear-projected display is based on VisBlocks, a stackable modular system from Visbox, Inc. Each block has a rigid frame and screen and an LCD projector, and blocks can be moved and stacked n a variety of configurations. The main advantage to this technology is seamlessness; there are no bezels between adjacent blocks. The facility contains 18 VisBlocks, each capable of displaying 1280x720 pixels; these are driven by nine PCs.Virtual and Augmented Reality Laboratory: The VR/AR laboratory provides space for students and faculty working on immersive virtual environments and augmented reality research. A key feature of the lab is the open tracked space allowing unencumbered use of head-mounted displays (HMDs). This 12x12-foot space is tracked with an Intersense IS-900 position tracking system. Other equipment in the lab includes Virtual Research and Sony HMDs, a Fakespace Immersive Workbench? stereoscopic display, a Polhemus Fastrak position tracking system with three receivers, Fakespace pinch glove input devices, and a variety of graphics workstations. 3D Interaction Laboratory: The 3DI laboratory supports research in 3D user interfaces and interaction techniques, as well as immersive virtual environments. Position tracking is provided in this laboratory by an Intersense IS-900 VET system and a Polhemus Fastrak system. In addition to the tracked input devices provided by these systems, the laboratory also provides advanced input devices such as Pinch Gloves, 5DT data gloves, a chord keyboard, Measurand ShapeTape, 3D Connexion SpaceBall, and various handheld mice. Display systems include a Virtual Research V8 HMD, and a two-wall rear-projected VisWall system capable of displaying stereoscopic imagery at 2800x1050 pixels. These walls are also reconfigurable and expandable.

General Departmental Resources

The Department maintains a centralized set of compute resources to support departmental email, backup, file serving, web serving and instruction. These resources include six servers that support virtual servers (via Xen hypervisor) for departmental e-mail, web and file serving; a fiber optic SAN to meet the storage and backup needs of the department; a tape library with off-site storage for backups; a 20 node cluster that supports undergraduate and graduate courses; and dedicated HVAC and UPS systems. In addition, various research groups offer special-purpose facilities to their members.

DEGREES OFFERED

MS Degree

Offered In (National Capital Region, Blacksburg)

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. 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.To enable the completion of both a bachelor's and a master's degree (B.S./M.S.) in five years, Virginia Tech allows students with a 3.5 or above GPA to apply for admission to the Graduate School on the completion of seventy-five hours of undergraduate study. Students in this program take four graduate courses during their senior year in place of the four required CS 4000-level courses. No more than two graduate-level courses should be taken in one semester while an undergraduate, and no more than a total of 12 graduate credits will count toward the undergraduate degree. An average of B (3.0) must be earned over the four graduate courses on the Undergraduate Program of Study. Award of the B.S. degree occurs on completion of 120 credits, including the 12 credits of graduate work and the other departmental and university core curriculum requirements. The remaining graduate courses for the M.S. degree should be taken after conferral of the B.S. degree and follow the requirements for the M.S. degree as set forth previously. Typically, a BS student transitions to the BS/MS program after completing 75 hours of undergraduate study and, after completing all the requirements of the undergraduate program, transitions to become a regular MS student.

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: o 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. o 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. o 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 (National Capital Region, Blacksburg)

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. To enable the completion of both a bachelor's and a master's degree (B.S./M.S.) in five years, Virginia Tech allows students with a 3.5 or above GPA to apply for admission to the Graduate School on the completion of seventy-five hours of undergraduate study. Students in this program take four graduate courses during their senior year in place of the four required CS 4000-level courses. No more than two graduate-level courses should be taken in one semester while an undergraduate, and no more than a total of 12 graduate credits will count toward the undergraduate degree. An average of B (3.0) must be earned over the four graduate courses on the Undergraduate Program of Study. Award of the B.S. degree occurs on completion of 120 credits, including the 12 credits of graduate work and the other departmental and university core curriculum requirements. The remaining graduate courses for the M.S. degree should be taken after conferral of the B.S. degree and follow the requirements for the M.S. degree as set forth previously. Typically, a BS student transitions to the BS/MS program after completing 75 hours of undergraduate study and, after completing all the requirements of the undergraduate program, transitions to become a regular MS student.

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: o 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. o 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. o 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.

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

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

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

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

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

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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CS 5224:

Systems Simulation

An in-depth treatment of systems simulation and simulation programming languages (SPLs). Input data modeling, simulation model formulation and representation, conceptual frameworks for modeling, a comparative study of some SPLs, principles of SPL design, statistical analysis of simulation output data, credibility assessment stages, model development environments. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CS 5244:
Internet Software
Languages and technologies needed to develop software for the Internet and world-wide web (WWW). Commonly used protocols and standards. Advanced technologies for distributed computation, component-based systems, interoperability with legacy systems, and database access. Principles and technologies for agent-based systems and electronic commerce. Credit will not be given for both 4244 and 5244.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

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

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

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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CS 5474 (MATH 5474) (BCHM 5344) (PPWS 5344):
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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

CS 5560 (ECE 5560):
Network and Computer Security
Introduces both fundamental security principles as well as real-world applications of network and computer security. Covers a wide range of topics including authorization and access control, basic cryptography, authentication systems, e-commerce security, sensor network security, and legal and ethical issues. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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 required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

CS 5566 (SOC 5214) (PAPA 5214) (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

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

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

CS 5624:

Introduction to Data Mining

Basic principle of data mining, including data analysis under uncertainty, modeling of data mining problems, data mining algorithms, scalability, and data integration and management. Applications of data mining in areas such as bioinformatics, electronic commerce, and geoinformatics. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CS 5634:

Data Management in Bioinformatics

Data models, query languages, and data management systems for bioinformatics applications. Logical data organization, functional dependencies, design of schemas, querying, manipulation, information integration, and data mining. Specialized data structures, interchange formats, and designs for applications such as sequencing and microarray analysis. Partially duplicates 5614. Prerequisite or graduate standing in CSA required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

CS 5814:

Digital Picture Processing

Representation and processing of greytone images. Construction and simulation of grey scales, digitization, thresholding, local neighborhood operations, template matching and filtering, enhancement and restoration, segmentation, connected components, matching, morphology. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CS 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

CS 5944:

Graduate Seminar

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

CS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

CS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

CS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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

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

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

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

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

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

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

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

CS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

CREATIVE TECHNOLOGIES

Kevin Concannon, Program Director

Professors: Carol Burch-Brown; Thomas Capone;

Associate Professors: Steve Harrison; Simone Paterson;

Assistant Professors: Ivica Bukvic; Benjamin Hannam; Eric Standley; Dane Webster;

General Contact: appleby@vt.edu

Graduate Contact: webster@vt.edu

Graduate Contact: dbannan@vt.edu

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

College of Architecture & Urban Studies: http://www.caus.vt.edu/

The Masters in Fine Arts (MFA) in Creative Technologies at Virginia Tech is a two-year, terminal degree program that prepares students to use computer applications to manipulate images and information. Through various media such as film, video, photography, computer animation, and digital soundtracks, students will learn to communicate messages that simulate real-world content. The program will address commercial, industrial, and entertainment needs through instruction in emerging trends and issues applicable in two emphasis areas: Interactive New Media and Design, and Digital Fabrication and Imaging.2

SPECIAL FACILITIES

Digital Fabrication Equipment, Animation Computer Labs, and Graduate Research Space

School of thte Visual Arts Facilities

The Art Armory The Art Armory is home to the school's main office, gallery, and classrooms for Foundations and Drawing. 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's spacious structure, high ceilings, and abundant natural light furnish a striking example of innovative architectural conversion. The Armory Art Gallery is operated as an educational and outreach service of the University. Its exhibition calendar includes work by students, faculty, and artists of regional and national importance. The 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. A prominent feature of the Armory is its 1700 sq. foot Mezzanine. (ADLC) Art & Design Learning Center (Painting, Ceramics, and Sculpture) The Art & Design Learning Center (ADLC) also known as "The Old Print Shop" houses the classroom space for Ceramics, Painting and Sculpture. The Ceramics studio is equipped with potter's wheels, slab rollers and hand building areas. The studio is divided into two areas, one for red clays and the second for light clays and porcelain. A glazing area and electric kilns are provided for decorating and firing. The Painting studios are supplied with painting easels, a large variety of still life objects and model set-ups. The studio is separated into two distinct teaching areas. One studio for introductory painting classes, and the other is for upper level painting classes. The Sculpture studio offers a workspace that allows students to create three-dimensional forms in a variety of media. A clay modeling area as well as wax, mold making, and wood working areas are available on a rotating basis. For more advanced students, a metalworking and casting facility is located off campus at the Prices Fork Research Station. 3D Animation Lab and Cyber Studio 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 a rack of 5 Mac Xserves for use as a render cluster and a state-of-the-art ABS Rapid Prototyper, used for outputting virtual models into Three-Dimensional forms for research and educational purposes. The Cyber Studio The Cyber Studio is a new Creative and Visual Research environment for both faculty and student usage. This Cyber Lab is collaboratively utilized by the (CCTAD) The Collaboration for the Creative Technologies in the Arts and Design Faculty and (DARC) the Digital Arts Research Collaborative for New Media and Creative Technologies Projects. Henderson Hall The SOVA /FourDesign In this new facility, these SOVA programs will also share this state of the art environment with the School of the Performing Arts & Cinema. The second floor of Henderson Hall facilitates a new collaborative teaching and student environment for the Visual Communication Design program. This space incorporates a unique and innovated community learning teaching environments and space for students to display work for critiques and professional-level photography of portfolio items.

DEGREES OFFERED

MFA Degree

Offered In (Blacksburg)

IELTS
TOEFL

Paper: (550.0)

iBT: (80.0)

60 credit hours and Thesis / Exhibition

CREATIVE WRITING

Joseph Eska, Chair

Professors: Frederick D'Aguiar; Edward Falco; Nikki Giovanni; Lucinda Roy;

Associate Professors: Robert Hicok; Jeffrey Mann;

Assistant Professors: Erika Meitner;

Affiliated Faculty: James Vollmer; Gyorgyi Voros;

University Distinguished Professor: Nikki Giovanni;

Alumni Distinguished Professor: Lucinda Roy;

Gloria D. Smith Professor of Africana Studies: Frederick D'Aguiar;

Graduate Contact: efalco@vt.edu

Graduate Contact: sallyw@vt.edu

Graduate Site: http://www.english.vt.edu/graduate/MFA/index.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 prepare students for teaching at the college-level.

SPECIAL FACILITIES

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 and a final exam are required.The 48 hours required for the degree must be distributed as follows:Creative writing workshops: 15 hours; 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: 3 hours minimum in the student's principal genre.Composition: 11 hours: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; up to 3 hours may come from an independent studies in Editing a Digital Journal or a form and theory class outside the student's principal genreWriters in Residence.

CROP AND SOIL ENVIRONMENTAL SCIENCES

Tommy Thompson, Head

Professors: Marcus Alley; Walter Daniels; Gregory Evanylo; Carl Griffey; Charles Hagedorn; Steven Hodges; James McKenna; David Parrish; Mohammad Saghai-Maroof; Lucian Zelazny;

Associate Professors: Azenegashe Abaye; Duane Berry; Matthew Eick; Erik Ervin; John Fike; John Galbraith; James Goatley; David Holshouser; Naraine Persaud; Mark Reiter; Christopher Teutsch; Benjamin Tracy; Carol Wilkinson; Carl Zipper;

Assistant Professors: Rory Maguire; Katy Rainey; Wade Thomason;

Research Faculty: Thomas Reed;

Emeritus Faculty: Glenn Buss; Raymond Reneau;

General Contact: saville@vt.edu

CSES website: http://www.cses.vt.edu

Graduate programs in the Department of Crop and Soil Environmental Sciences (CSES) lead to both the M.S. (non-thesis and thesis options) and the Ph.D. degrees. The principal objective of graduate education programs is to educate students in advanced concepts and research methods in one or more subdisciplines of CSES and related programs. This is accomplished through courses and research that bridge a number of physical and biological sciences. Individually planned programs of study are developed to provide training and experience in environmental resource management and control, seed physiology, crop physiology, plant genomics and breeding, plant cell and developmental biology, tissue culture, and molecular genetics, and in the biochemistry, mineralogy, fertility, chemistry, classification, genesis, interpretation, microbiology, and physics of soils. The Department also participates in several interdisciplinary degrees at the M.S. and Ph.D. level.

SPECIAL FACILITIES

The department has extensive facilities, instruments and equipment for many kinds of research and teaching in crop, soil and environmental sciences. Laboratories are instrumented for physiological research on seeds and whole plants; forage quality analyses; for plant cellular/molecular biology, tissue culture, molecular genetics, and breeding research on crop plants; for micro-biological research in water quality, nitrogen fixation and biological control of plant diseases; for modelling research on contaminant movement to ground-water; for soil chemistry and physics research on waste product utilization; for soil testing and plant analysis research on nutrient recycling and on economic inputs in crop production; for soil genesis research relative to land use and soil taxonomy; and for soil mineralogy and physical chemistry research on soil acidity and on thermodynamics and kinetics of anion and cation reactions in soils. In addition to departmental laboratories, traditional agronomic equipment, greenhouses and extensive field facilities at Blacksburg, the Virginia Agricultural Experiment Station has research facilities at twelve locations throughout Virginia. Of particular note are field facilities for grazing research and forage-livestock systems, turfgrass, tobacco, peanut, soybean, corn, and small grains research. Excellent computer and library facilities are available. Also available on campus are electron microscopes, and an electron probe, a mass spectrograph, and facilities for biotechnological research.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

Establishing a Committee - The advisor and student will select an Advisory Committee no later than the end of the first semester of residence. The minimum number of members for the advisory committee are 3 for M.S. students, and 4 for Ph.D. students. The Ph.D. committee must have at least one member from outside the Department. At this meeting, the committee will become familiar with the student's training, background, and research interests. The committee also will orient and advise the student regarding research and course-work. Plan of Study: Students are expected to present to their major advisor a draft Program of Study that meets all requirements. After review and approval by the major advisor, the Plan of Study must be reviewed and approved by all members of the students advisory committee. After approval, the Plan of Study is submitted to the Graduate School through the Student Administration Center in the Department. It is the student's responsibility to see that the Plan Study is submitted to the Graduate School on time (prior to completing 12 credit hours toward the M.S. degree, and before completing 18 credit hours beyond the M.S. toward the Ph.D. degree. Changes to the Plan of Study must be approved by the advisory committee and submitted to the Graduate School through the Student Administration Center. Outline of Proposed Research - As research is initiated for a degree, a Research Proposal will be presented in writing and orally to the student's Advisory Committee. This proposal should include sections containing: (a) an abbreviated literature search; (b) clear and concise objectives; (c) proposed experimental procedures; and (4) data analysis and presentation procedures. The purpose of this requirement is to determine whether the research proposed is adequate to satisfy degree requirements and to assist the student in clarifying objectives and procedures. The time to present the proposal should be determined by the major advisor and the committee. Students are encouraged to begin this process as soon as possible in order to complete their studies in a timely manner and with minimal wasted efforts!Report on Research - Each graduate student will present an annual progress report (one page maximum) to his/her Advisory Committee and other interested persons prior to the final examination. The purpose of such reports is to evaluate the research progress and make suggestions for modifications or additions to the research objectives or procedures. A copy of the report is to be provided to the Graduate Coordinator. Preliminary Examination - Candidates for the Ph.D. degree should schedule the Preliminary Examination at an early date. This will allow the student time to take courses that the Advisory Committee may require to correct deficiencies. The preliminary examination must be taken at least nine months before graduation and prior to completing 2/3 of the required work (course work and/or research) for the degree.Preparation of Theses/Dissertations or Non-Thesis M.S. Project Reports - The student, with the assistance of his or her major professor, has the responsibility for preparation of the thesis/dissertation/project report. While the Graduate School specifies certain formats, it leaves matters of style largely to departments, but urges that the style conform to the major professional or scientific journals in the student's area of interest. Therefore, the CSES Department suggests that theses/dissertations/project reports follow the style of journals of the American Society of Agronomy or other sources acceptable by the committee. Students may find that certain mechanical considerations for manuscripts will differ between ASA's and those specified by the Graduate School. Follow the Graduate Policies and Procedures in such cases. Preparation of the thesis/dissertation/project report in proper style will facilitate the preparation of manuscripts for publication. All theses and dissertations must be submitted to the Graduate School in electronic format. Seminars are given by the Graduate School each semester to familiarize students with the procedures needed to prepare the electronic submission. Students are expected to know these procedures and prepare the thesis or dissertation to meet all requirements.Each section of the thesis/dissertation/project report should be prepared to the satisfaction of the Major Professor before being given to the other members of the Advisory Committee for review. Each section is to be provided to the committee members as it is completed. All sections of the thesis/dissertation are to be reviewed by the committee at least 30 days prior to the examination. Students will provide the members of the Advisory Committee the complete and revised thesis/dissertation at least 10 days prior to the oral examination/defense. Even though each member of the Advisory Committee will have provided suggestions or requirements for revisions of the thesis/dissertation/project report prior to the final examination, some corrections or additions will always be necessary even following a successful final examination. The Graduate School allows a period of two weeks after the final examination to submit the final version of the thesis or dissertation. The final project report is submitted only to the Major Advisor and Advisory Committee.Foreign Language Requirement - The department does not require a foreign language for any degree.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal, Quantitative, Analytical

Establishing a Committee - The advisor and student will select an Advisory Committee no later than the end of the first semester of residence. The minimum number of members for the advisory committee are 3 for M.S. students, and 4 for Ph.D. students. The Ph.D. committee must have at least one member from outside the Department. At this meeting, the committee will become familiar with the student's training, background, and research interests. The committee also will orient and advise the student regarding research and course-work. Plan of Study: Students are expected to present to their major advisor a draft Plan of Study that meets all requirements. After review and approval by the major advisor, the Plan of Study must be reviewed and approved by all members of the students advisory committee. After approval, the Plan of Study is submitted to the Graduate School through the Student Administration Center in the Department. It is the student's responsibility to see that the Plan of Study is submitted to the Graduate School on time (prior to completing 12 credit hours toward the M.S. degree, and before completing 18 credit hours beyond the M.S. toward the Ph.D. degree. Changes to the Plan of Study must be approved by the advisory committee and submitted to the Graduate School through the Student Administration Center. Outline of Proposed Research - As research is initiated for a degree, a Research Proposal will be presented in writing and orally to the student's Advisory Committee. This proposal should include sections containing: (a) an abbreviated literature search; (b) clear and concise objectives; (c) proposed experimental procedures; and (4) data analysis and presentation procedures. The purpose of this requirement is to determine whether the research proposed is adequate to satisfy degree requirements and to assist the student in clarifying objectives and procedures. The time to present the proposal should be determined by the major advisor and the committee. Students are encouraged to begin this process as soon as possible in order to complete their studies in a timely manner and with minimal wasted efforts!Report on Research - Each graduate student will present an annual progress report (one page maximum) to his/her Advisory Committee and other interested persons prior to the final examination. The purpose of such reports is to evaluate the research progress and make suggestions for modifications or additions to the research objectives or procedures. A copy of the report is to be provided to the Graduate Coordinator. Preliminary Examination - Candidates for the Ph.D. degree should schedule the Preliminary Examination at an early date. This will allow the student time to take courses that the Advisory Committee may require to correct deficiencies. The preliminary examination must be taken at least nine months before graduation and prior to completing 2/3 of the required work (course work and/or research) for the degree.Preparation of Theses/Dissertations or Non-Thesis M.S. Project Reports - The student, with the assistance of his or her major professor, has the responsibility for preparation of the thesis/dissertation/project report. While the Graduate School specifies certain formats, it leaves matters of style largely to departments, but urges that the style conform to the major professional or scientific journals in the student's area of interest. Therefore, the CSES Department suggests that theses/dissertations/project reports follow the style of journals of the American Society of Agronomy or other sources acceptable by the committee. Students may find that certain mechanical considerations for manuscripts will differ between ASA's and those specified by the Graduate School. Follow the Graduate Policies and Procedures in such cases. Preparation of the thesis/dissertation/project report in proper style will facilitate the preparation of manuscripts for publication. All theses and dissertations must be submitted to the Graduate School in electronic format. Seminars are given by the Graduate School each semester to familiarize students with the procedures needed to prepare the electronic submission. Students are expected to know these procedures and prepare the thesis or dissertation to meet all requirements.Each section of the thesis/dissertation/project report should be prepared to the satisfaction of the Major Professor before being given to the other members of the Advisory Committee for review. Each section is to be provided to the committee members as it is completed. All sections of the thesis/dissertation are to be reviewed by the committee at least 30 days prior to the examination. Students will provide the members of the Advisory Committee the complete and revised thesis/dissertation at least 10 days prior to the oral examination/defense. Even though each member of the Advisory Committee will have provided suggestions or requirements for revisions of the thesis/dissertation/project report prior to the final examination, some corrections or additions will always be necessary even following a successful final examination. The Graduate School allows a period of two weeks after the final examination to submit the final version of the thesis or dissertation. The final project report is submitted only to the Major Advisor and Advisory Committee.Foreign Language Requirement - The department does not require a foreign language for any degree.

GRADUATE COURSES (CSES)

CSES 5004:

Graduate Seminar

Lectures and discussions by faculty and graduate students on current research topics in the areas of crop science, soil science and environmental quality. May be repeated. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

CSES 5064:

Turfgrass Science Seminar

Critical review of current journal articles addressing research topics in turfgrass physiology, ecology, cultural programming, pathology, entomology, and weed science. Pre-requisite: Graduate Standing required.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

CSES 5114:

Soils for Professionals

Characterization of soils as a natural resource emphasizing their physical, chemical, mineralogical, and biological properties in relation to nutrient availability, fertility, plant growth, land-use management, waste application, soil and water quality, and food production. Calculations used in land-use management. Pre: One year of introductory biology and chemistry. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

CSES 5124:

Topics in Soil Genesis

Topics in soil genesis of regional interest will be addressed. This is a one-week field course that will rotate each year among four regions in the northeastern United States. The regions are Virginia-Maryland, Pennsylvania-West Virginia, New York, and the New England states. This will provide students the opportunity to observe and study soils in the field over a much broader geographic area that otherwise is not possible in a conventional semester course. May be repeated. III

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab

CSES 5214:

Soil-Plant Relationships

An interdisciplinary study of soil-plant relationships, with particular emphasis placed on soil chemical and physical properties and their influence on plant growth and development. Topics studied include: root growth, soil compaction, water in the soil-plant-atmosphere continuum, soil acidity, nutrient movement to plant roots, soil aeration, and nitrogen in the soil-plant environment. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CSES 5304 (HORT 5304):

Advanced Plant Genetics and Breeding

Plant breeding theory and methodology for the improvement of argonomic and horticultural crops; genetic diversity; polyploidy; gene inheritance, expression, interaction, and stability; incompatibility; male sterility; haploidy; genetic engineering and transformation; parental selection, hybridization, and population development; breeding methods, genotypic and phenotypic line selection and evaluation; strategies for cultivar development including marker assisted selection and breeding for durable disease resistance. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

CSES 5344:

Advanced Crop Physiology

Physiological considerations in a crop community: light interception, gas exchange, water stress, flowering, and senescence; key metabolic processes that most directly affect yield: photosynthesis (C3 and C4), photorespiration, and N-metabolism; cropping systems as symbioses. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CSES 5544:

Soil-plant-animal Interrelationships in Grasslands

The principles of plant competition and succession during the establishment and maintenance of herbaceous species and communities are interrelated to soil, biotic, and microclimatic factors and their interactions. Ecological and nutritional principles embodying plant and animal factor in the utilization of herbaceous plants by livestock are established. Research methodology in grassland systems is presented. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CSES 5554:

Ecology of Grazing Land Systems

A multi-disciplinary, multi-institution, field course. Students travel through diverse ecosystems studying the components and functions of grazing lands. Attention is to: (a) how components and functions vary to ecoregion; (b) research needs, objectives, and techniques in soil-plant - animal research; (c) forage-livestock ecology and systems in crop-, pasture-, range-, and forestlands; (d) the role of forages in conservation, wildlife habitat, and sustainable agriculture; and (e) industries involved with forages and livestock. given to: (a) how components and functions vary by ecoregion; (b) research needs, objectives, and techniques in soil-plant-animal research; (c) forage- livestock ecology and systems in crop-, pasture-, range-, and forestlands; (d) the role of forages in conservation, wildlife habitat, and sustainable agriculture; and (e) industries involved with forages and livestock. X grade applies.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture

CSES 5604:

Environmental Science Concepts for Professionals

Physical, chemical, and biological principles and processes that are central to human-environment interactions. Emphasizes air and water resoures and the role of energy in human and natural systems. Major U.S. environmental legislation and regulations. Pre: Two semesters each of college chemistry and biology and one semester of economics. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

CSES 5634:

Soil Chemistry

Chemical and colloidal properties of clays and organic matter in soil systems including ion exchange, retention and precipitation; soil acidity and salinity; mineral weathering and formation; oxidation-reduction reactions; trace and toxic elements, and organic pollutants in soils. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

CSES 5694:

Soil Biochemistry

Comprehensive presentation and analysis of the biochemistry of soil humic acid formation, physicochemical properties of humic substances, and interactions of soil humic substances with toxic organics and metals.

Microbial degradation of organics, including pesticides, and the fate of genetically engineered microbes in soil. II
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

CSES 5734:

Clay Mineralogy

Structure, composition, classification, identification, and properties of clay minerals; emphasis on characteristics of mixed-phase systems in sediments and soils. II
Credit Hour(s): 0 OR 4
Lecture Hour(s): 0 OR 3
Instruction Type(s): Lab, Lecture

CSES 5744G:

Adv Managed Ecosys Serv & Sust

Interactions of climate, soils, and organisms within intensively managed ecosystems used to produce food, energy, water, recreation, and other essential ecosystem services. Models of ecosystem development, role of disturbance, application of ecological theory and concepts to agricultural, grassland, and urban/turf ecosystems. Regional and global significance in sustainable food systems, and global ecosystem assessment. Pre-requisite: Graduate Standing and knowledge of basic soil science required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CSES 5774:

Advanced Rehabilitation of Disturbed Lands

Advanced study of human disturbance of soils and landscapes and various remediation strategies. Global environmental impacts of coal and metal mining, mineral processing, highway-utility corridor development, and urbanization. Acid mine drainage and treatment, including use of artifical wetlands. Study tours and field project. May not be taken after CSES 4774 or CSES 5874. Graduate standing required.
Credit Hour(s): 0 OR 4
Lecture Hour(s): 0 OR 3
Instruction Type(s): Lab, Lecture

CSES 5844:

Plant Genomics

Comprehensive overview of genomics and its applications. Topics include: molecular markers, map construction, map-based cloning, quantitative trait loci, and functional genomics. Even Years. Pre: Knowledge of general principles of genetics and molecular biology. I.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CSES 5854:

Advanced Wetland Soils

Hydric soil identification and delineation, wetland water budgets, restoration of damaged wetlands, and creation of compensation wetlands. Utilization of advanced soil information systems and GIS/GPS in wetlands study. Constructed wetlands for water treatment. Mandatory 3 -day field trip. May not be taken after CSES/ENSC 4854. Graduate standing required. Odd years. I.
Credit Hour(s): 0 OR 4
Lecture Hour(s): 0 OR 3
Instruction Type(s): Lab, Lecture

CSES 5864:

Advanced Wetland Soils and Mitigation

Wetland soils as components of natural landscapes and their interactions with hydrologic systems. Hydric soil identification and delineation, preparation of wetland water budgets, restoration of damaged wetlands, and creation of compensation wetlands. Utilization of advanced soil information systems and GIS/GPS in wetlands study. Constructed wetlands for nutrient removal and acid mine drainage treatment.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

CSES 5874:

Reclamation of Disturbed Lands

Human disturbances of soils and landscapes and various remediation strategies. Environmental impacts of coal and metal mining, mineral processing, highway or utility corridor development, and urbanization. Field and lab testing protocols; development of site-specific revegetation protocols. Acid mine drainage and treatment, including use of artificial wetlands.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

CSES 5904:

Project and Report

Project for non-thesis Masters of Science degree option. To constitute 3 to 6 of the 30 credit hours required for the degree. This course will emphasize critical interpretation, review, and oral/written reporting of an assigned topic. Review grade only. May be repeated. I,II,III

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

CSES 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

CSES 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

Instruction Type(s): Lab, Lecture

CSES 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

CSES 6634:

Soil Physical and Colloidal Chemistry

Rigorous theoretical and applied treatments of soils and molecular adsorption, desorption, distribution, and exchange from soil colloidal systems. II

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

CSES 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

DAIRY SCIENCE

Robert Akers, Head

Professors: Robert Akers; Robert James; Charles Stallings;

Associate Professors: Mark Hanigan; Katharine Knowlton;

Assistant Professors: Benjamin Corl; Isis Mullarky; Christina Petersson-Wolfe;

Horace E. and Elizabeth F. Alphin: Robert Akers;

General Contact: mullarky@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) or 213 (computer based test) is required. Three letters of recommendation are required. We request that your references complete the Graduate School Reference Form and send it directly to Becky Michael, Graduate Coordinator for Dairy Science. 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 non-refundable fee ~ $50. 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

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 Cattle Center, located on 600 acres of land at the southwest edge of campus, maintains over 400 head of dairy animals in both conventional and a new free-stall cattle housing unit. The complex includes a milking parlor, calf barn, bull barn complete with semen collection area, and other facilities for feed storage, etc. At our current on campus farm, the principle structure is a teaching and research freestall barn for approximately 250 cows, with an attached milking parlor. The freestall area is industry standard with the built-in ability to house animals in relatively small groups for teaching and research use, and the addition of self locking head gates and a drover's alley. Additionally, 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: (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. 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 and 2) scheduled their final exam to take place within the first 20 class days of the term, 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. 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 and 2) scheduled their final exam to take place within the first 20 class days of the term, 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

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

DASC 5474:

Dairy Management Decisions

Principles and techniques of evaluating dairy management alternatives, with emphasis on integration of interest, borrowed capital, income taxes, and risk in the decision process. Effective use of microcomputers, production records, and modeling techniques to evaluate management strategies. Even years. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

DASC 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research

DASC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

DASC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

DASC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ECONOMICS

Nicolaus Tideman, Head

Professors: Richard Ashley; Robert Gilles; Hans Haller; Amoz Kats; Djavad Salehi-Isfahani; Aris Spanos; Thorwald Tideman;

Associate Professors: Sheryl Ball; Richard Cothren;

Assistant Professors: Eric Bahel; Suqin Ge; Joao Macieira; Kwok Tsang; Zhou Yang;

Visiting Faculty: Earl Davis; Steven Trost;

Wilson Schmidt Professor: Aris Spanos;

Graduate Program Administrator: econgrad@vt.edu

Graduate Program Director: ashleyr@vt.edu

Graduate Program: http://www.econ.vt.edu/graduate/graduate.htm

Student Handbook:

http://graduate.agecon.vt.edu/Student%20Planning%20Guide.pdf

The Virginia Tech Economics program was established September 1, 1961. The program has awarded more than 200 Ph.D.s 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 Department of Economics and Agricultural and Applied Economics.

SPECIAL FACILITIES

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)

GRE

General Test: Quantitative (600.0)

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.

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

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

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

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

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

ECON 5125 (AAEC 5125) (HNFE 5694) (PHS 5044):

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

ECON 5126 (PPWS 5064) (EDCI 5124) (ALS 5064) (MUS 5224) (BIOL 5064) (BCHM 5064) (PSCI 5115) (GIA 5115) (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

ECON 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECON 5945 (AAEC 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

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

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

ECON 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ECON 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ECON 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

ECON 6044:

Collective Choice

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

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

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

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

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

ECON 6304 (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

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

ECON 6454:

Dynamic Analysis

Advanced treatment of the analysis and optimization of dynamic economic systems using mathematical tools and analytic concepts. Topics include: optimal control theory; dynamic programming; economics of resource allocation over time, and stochastic optimization models. Permission of course instructor required. Alternate years. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECON 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

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

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

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

ECON 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

EDUCATION, CAREER AND TECHNICAL EDUCATION

William Price, Program Director

Associate Professors: William Price; Daisy Stewart;

Affiliated Faculty: Thomas Broyles; Donna Moore; Rickie Rudd;

Emeritus Faculty: Konrad Eschenmann;

General Contact: wprice@vt.edu

Graduate Contact: daisys@vt.edu

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

The Career and Technical Education (CTE) program at Virginia Tech is one of the top CTE graduate programs in the United States. Currently the program is tied for 4th in the country as ranked by U.S. News and World Report, and it has been a top-10 selection 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 doctoral program is primarily for individuals wishing to pursue a CTE teacher education position at a college or university. 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

DEGREES OFFERED

MSED Degree

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

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. The Ed.S. and doctoral degrees require minimums of 60 and 90 credits beyond the bachelor's degree, respectively. 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 requirements for the different master's degree concentrations vary and also depend on the student's background and goals. The Ed.S. and doctoral degrees require minimums of 60 and 90 credits beyond the bachelor's degree, respectively. 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 requirements for the different master's degree concentrations vary and also depend on the student's background and goals. The Ed.S. and doctoral degrees require minimums of 60 and 90 credits beyond the bachelor's degree, respectively. 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)

The requirements for the different master's degree concentrations vary and also depend on the student's background and goals. The Ed.S. and doctoral degrees require minimums of 60 and 90 credits beyond the bachelor's degree, respectively. Please see the CTE program web site and consult an advisor for specific information.

GRADUATE COURSES (EDCT)

EDCT 5114:

C&I in CTE: Prof Perspectives

Designed to provide provisionally licensed teachers in career and technical education (CTE) with an overview of roles and relationships within the teaching profession. Develops their knowledge of factors and resources for program planning and liability and safety issues for teachers. This is the first course in a sequence of six, one-credit courses.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

EDCT 5124:

C&I in CTE: Basics of Curr

Designed to provide provisionally licensed teachers in career and technical education (CTE) with instruction in the basics of planning and developing curriculum including needs analysis, course and unit planning, and student assessment. This is course two in a sequence of six one-semester hour courses.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

EDCT 5134:

C&I in CTE: Instr Strategies

Designed to provide provisionally licensed teachers in career and technical education with instruction in developing and delivering curriculum. Further develops the teacher's ability to use a variety of teaching strategies to meet the diverse population of students. This is the third course in a sequence of six, one-credit courses. Must have prerequisite or permission of the instructor.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

EDCT 5144:

C&I in CTE: Adv Instr Strat

Designed to provide provisionally licensed teachers in career and technical education with advanced instruction in developing and delivering curriculum. Develops the teacher's ability to use technology in instruction and to supervise work-based programs. This is the fourth course in a sequence of six, one-semester credit courses. Must have prequisite or0000000 permission of the instructor.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

EDCT 5154:

C&I in CTE: Prof Dev-Prog Mgt

Designed to provide provisionally licensed teachers in career and technical education (CTE) with instruction in a variety of program management tools related to their own professional development, their student organizations, and their program administration. This is course five in a sequence of six one-semester hour courses.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

EDCT 5164:

C&I in CTE: Diverse Learners

Designed to provide provisionally licensed teachers in career and technical education (CTE) with an understanding of the importance of diversity in our society, schools, and the workforce. Categories and characteristics related to diversity and disabilities are discussed, and assignments develop skills in adapting curriculum and instruction to best meet student needs. This is the sixth course in a sequence of six, one-credit courses.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

EDCT 5644:

Curriculum and Program Planning in Career and Technical Education

Concepts and principles involved in curriculum and planning of career and technical education programs. Learning experiences focus on school and community needs assessment, curriculum content identification and selection, designing curricula, and assessing curriculum materials and processes. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

EDCT 5684:

Education and Employment Preparation for Diverse Populations

Study of policy and practices for developing and implementing career and technical education and employment programs that meet the needs of diverse/special needs, those youth and adults with disabilities, disadvantaged, limited English proficient, ethnic minorities, incarcerated youths, and single/teen parents. Specific attention to federal and state legislation and trends; the education foundation, programs and practices, which prepares students for career and technica education and training; and employment practices and programs. I, II, III.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

EDCT 5694:

Career and Technical Education for Adults

Focus is on the role, rationale, and teaching strategies for those adult learners enrolled in Career and Technical Education programs. Advanced content drawing heavily from contemporary trends and issues on the adult learner as synthesized from current research.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

EDCT 5734:
Transition Programming for Individuals with Disabilities
Indepth study of transition policy, programs, procedures and services for diverse populations. Focus of course is on the comprehensive transition process including preparation for employment, post-secondary education and training, independent living skills, skills in accessing community services, social skills, recreation and leisure skills. Effective educational programming, community services, tansition planning, and collaboration between education and community services at the secondar level will be emphasized. I, II, III
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

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

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

EDCT 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

EDCT 5954:
Study Abroad
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

EDCT 5964:
Field Study
Credit Hour(s): 1 TO 12
Lecture Hour(s): 1 TO 12
Instruction Type(s): Lecture

EDCT 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Independent Study

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

EDCT 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

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

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

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

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

EDCT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

EDCT 7754:

Internship in Education

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

EDCT 7964:

Field Studies in Education

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

EDCT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

EDUCATION, COUNSELOR EDUCATION

Norma Day-Vines, Program Director

Associate Professors: Nancy Bodenhorn; Pamelia Brott; Norma Day-Vines; Gerard Lawson;

Assistant Professors: Simone Lambert; Laura Welfare;

Graduate Contact: nanboden@vt.edu

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

The Virginia Tech Counselor Education program offers a master's program (M.A.) at the National Capital Region and at the Virginia Tech Roanoke Center and a doctoral program (Ph.D.) at the National Capital Region and at the main campus in Blacksburg. The Virginia Tech Counselor Education Master's program is a 54 credit hour program, which generally takes a full-time student two years to complete. The first semester of the program consists of classroom study, and beginning in the second 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. They may also accrue supervision hours toward licensure (LPC) by the Virginia Department of Health Professions while serving as a school counselor.Those who graduate with a master's degree in the community counseling track may be employed in community mental health settings which do not require licensure, and they normally accrue the required supervision hours toward licensure (LPC) by the Virginia Department of Health Professions in those settings.The Virginia Tech Counselor Education Ph.D. 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 Ph.D. program typically seek employment in a variety of mental health settings and higher education, as well as K-12 schools. At the conclusion of their course work, they will normally have completed the courses necessary for the LPC in Virginia.

SPECIAL FACILITIES

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 51 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 (National Capital Region, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The masters programs require a minimum of 51 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

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

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

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

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

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

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

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

EDCO 5354:

Counseling the Substance Abuser

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

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

EDCO 5374:

Community Counseling

Designed for counselors who are interested in understanding, learning, and/or working as a counseling professional in a community counseling setting. Familiarizes students with community counseling and prepares them with skills for that setting. Examines concepts of social intervention, implications for the counseling process, the role of the community counselor, prevention in community counseling and current controversies and issues.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

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

EDCO 5624:

Externship in Education

Special problem-solving clinics for experienced educational practitioners who are engaged part-time in graduate study while continuing in positions of leadership in education. Faculty work with groups of experienced administrators, student personnel workers, supervisors, or instructors in systematic analysis of current educational problems and evaluation of educational practice. Students judged on quality of their investigations, reports, and discussion. (Maximum 12C).

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

EDCO 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

EDCO 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

EDCO 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

EDCO 6414:

Advanced Group Counseling

Design, delivery, and facilitation of group counseling content at an advanced level. Students supervise group counseling practices of graduate students taking the basic master's course. Students participate in an intensive interpersonal examination of personal behavior in a group setting and derive implications for group facilitation from both the experiential and reading bases. Extensive coursework and experience in counseling required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

EDCO 6914:

Problems in Education

Study of contemporary problems in various education settings such as administration, counseling, community college education, and adult and continuing education. (Maximum 3C per course).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

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

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

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

EDCO 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

EDUCATION, CURRICULUM AND INSTRUCTION

Professors: Susan Asselin; Bonnie Billingsley; John Burton; Katherine Cennamo; James Garrison; Barbara Lockee; Susan Magliaro; Kerry Redican; H Sutphin;

Associate Professors: Mary Barksdale; Brenda Brand; Peter Doolittle; George Glasson; David Hicks; Brett Jones; Billie Lepczyk; Heidi Mesmer; Patrick O'Reilly; William Price; Daisy Stewart; John Wells; Jesse Wilkins; Thomas Williams;

Assistant Professors: Carol Brandt; Jennifer Brill; Michael Evans; Sara Kajder; Bettibel Kreye; Kelly Parkes; Amy Parlo; Gresilda Tilley-Lubbs;

Affiliated Faculty: Francine Anderson; Delmas Bolin; Per Brolinson; Thomas Broyles; Charles Burnsed; Joseph Cacioppo; Cathleen Callahan; Jill Cramer; Igor Danelisen; Edward Ewing; David Harden; J Head; John Kauffman; Gwendolyn Lloyd; James Mahaney; Hara Misra; John Moore; Selen Olgun; James Palmieri; Kenneth Potter; Frederic Rawlins; Rickie Rudd; Judith Shrum; Harry Simmons;

Dixie Tooke-Rawlins; James Washenberger; Thomas Wilkinson; James Wolfe;

Emeritus Faculty: Konrad Eschenmann; Patricia Kelly; Stephen King; David Moore; Richard Stratton; Josiah Tlou; Larry Weber;

Instructor(s): Kenneth Potter;

General Contact: daisys@vt.edu

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

The Curriculum and Instruction graduate degrees are offered by 14 programs included in two departmental units in the School of Education. Listed below is contact information for the two departmental units and all of the programs in each unit, followed by degree information for the programs that use the Curriculum and Instruction degrees. Information for the two programs that have separate degrees is provided elsewhere in the Graduate Catalog. Learning Sciences and Technologies Departmental UnitDepartment Unit Chair: Kerry Redican (kredican@vt.edu, 211 War Memorial Hall, 540-231-5743)Web site: http://www.soe.vt.edu/lst/index.htmlEducational PsychologyProgram Leader: Brett Jones (jones1@vt.edu, 321 War Memorial Hall, 540-231-1880)Web site: http://www.soe.vt.edu/edpsych/index.html Health PromotionProgram Leader: Kerry Redican (kredican@vt.edu, 211 War Memorial Hall, 540-231-5743)Web site: http://www.soe.vt.edu/hp/index.html (See Health and Physical Education for degree information.)Instructional Design and TechnologyProgram Leader: John Burton (jburton@vt.edu, 144J Smyth Hall, 540-231-7020)Web site: http://www.soe.vt.edu/idt/index.html Teaching and Learning Departmental UnitDepartmental Unit Chair: Susan Asselin (sasselin@vt.edu, 300E War Memorial Hall, 540-231-8206),http://www.soe.vt.edu/tandl/index.html Career and Technical EducationProgram Leader: Bill Price (wprice@vt.edu, 206 War Memorial Hall, 540-231-7390)Web site: http://www.soe.vt.edu/cte/index.html (See Career and Technical Education for degree information.)Elementary EducationProgram Leader: Mary Alice Barksdale (mbarksda@vt.edu, 307 War Memorial Hall, 540-231-3166)Web site: http://www.soe.vt.edu/elementaryed/index.html English EducationProgram Leader: Sara Kajder (skajder@vt.edu, 316 War Memorial Hall, 540-231-8339)Web site: http://www.soe.vt.edu/englished/index.html Foundations of EducationProgram Leader: Jim Garrision (wesley@vt.edu, 400B War Memorial Hall, 540-231-8331)Web site: http://www.soe.vt.edu/foundations/index.html History and Social Science EducationProgram Leader: David Hicks (hicks@vt.edu, 313 War Memorial Hall, 540-231-8332)Web site: http://www.soe.vt.edu/socialstudiesed/ Integrative STEM EducationProgram Leader: John Wells (jgwells@vt.edu, 315 War Memorial Hall, 540-231-8471)Web site: http://teched.vt.edu/TE/STEM.html Mathematics EducationProgram Leader, Secondary Licensure in Mathematics: Betti Kreye (bkreye@vt.edu, 300F War Memorial Hall, 540-231-8348)Program Leader, Mathematics Specialist: Jay Wilkins (wilkins@vt.edu, 300C War Memorial Hall, 540-231-8326)Web site: http://www.mathed.soe.vt.edu/ Music EducationProgram Leader: Kelly Parkes (kparkes@vt.edu, 322B War Memorial Hall, 540-231-0765)Web site: 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)Web site: http://www.soe.vt.edu/literacy/index.html Science EducationProgram Leader: George Glasson (glassong@vt.edu, 319 War Memorial Hall, 540-231-8346)Web site: http://www.soe.vt.edu/scied/ Second Language EducationProgram Leader: Griselda (Kris) Tilley-Lubbs (glubbs@vt.edu, 304 War Memorial Hall, 540-231-4658)Web site: http://www.soe.vt.edu/secondlanguage/ Special EducationProgram Leader: Bonnie Billingsley (bbilling@vt.edu, 309 War Memorial Hall, 540-231-8335)Web site: http://www.soe.vt.edu/specialed/index.html Technology EducationProgram Leader: John Wells (jgwells@vt.edu, 315 War Memorial Hall, 540-231-8471)Web site: http://www.teched.vt.edu/

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)

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

EDCI 5114:

Advanced Educational Psychology

Psychological theories and models which serve as a basis for educational models and practice. Emphasis on conceptions of learning and the learning process.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

EDCI 5124 (PPWS 5064) (ALS 5064) (MUS 5224) (BIOL 5064) (BCHM 5064) (ECON 5126) (PSCI 5115) (GIA 5115) (AAEC 5126):

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. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

EDCI 5154:

Psych Foundations for Teachers

Emphasises applying human learning and developmental theories to classroom settings including school learning theories, child and adolescent cognitive development, instructional strategies, classroom management, student motivation, and learning assessment strategies. Graduate Standing Required. Admission in a graduate teacher education program or instructor permission required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

EDCI 5164:

Principles of Instructional Design

Logical and empirical foundations for the selection of instructional events. Includes design methodologies, principles, and instructional strategies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

EDCI 5194:

Research Assessing Student Achievement

Theoretical, empirical and practical foundations of classroom assessment of student achievement, including measurement theory, assessment construction, and developing the skills to be a teacher researcher. Emphasis on norm and criterion reference tests, selection and supply assessment items, outcome based assessment, alternative assessment strategies, and teacher as researcher design. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

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

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

EDCI 5274:

Specific Lrning Disabilities: Concepts, Theories, Characteristics & Issues

Detailed study of current concepts for identifying learning disabilities. Analysis of characteristics exhibited by individuals with specific learning disabilities and etiological theories. Examination of major field developments, current issues, and factors influencing programmatic change. Emphasis on current research findings.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

EDCI 5284:

Teaching Students With Specific Learning Disabilities

Study of holistic instructional needs and specific requirements of individualized educational programs for learning disabled students. Analysis of instructional methods and materials used for individuals with learning disabilities. Examination of frequently displayed problems and strategies to accommodate varying disabilities in basic skills, content areas, and life skills. Analysis of effective procedures for program organization, instruction, evaluation, and communication.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

EDCI 5294:

Methods of Teaching Students with Emotional and Behavioral Disorders

This course examines educational approaches that teachers can use to support children and youth who display social, emotional, and behavioral disorders. Emphasis will be placed on educational planning and program options, supportive interventions, and environmental and task management strategies to promote social-emotional development and well-being within the school setting.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

EDCI 5314:

Educational Applications of Microcomputers

A basic familiarization course for in-service teachers and other school personnel. Focus on computer literacy and specialized applications of microcomputers in school settings. Introduction to microcomputer hardware, CAI, and other local-school applications software. Microcomputer lab time required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

EDCI 5354:

Literacies and Technology

The course will assist educators in the study of computer based technologies and the technological proficiency of students (K-12) within literacy development. Designed to prepare educators with knowledge of existing programs, uses of communication systems, and the development of presentation, web-based and software programs for use in the classroom.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

EDCI 5384:

Evaluation and Supervision of Instruction

Principles and methods of evaluation applied to instruction, educational programs, materials, and personnel. Principles and practices of supervisory techniques designed to improve instruction and learning.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

EDCI 5464:

Adolescent Development

Advanced study of the physical, cognitive, social, and emotional development of the adolescent with emphasis on theoretical issues, research findings, and application of theory and research. Implications for education are highlighted.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

EDCI 5474:

Adapting Curriculum and Instruction for Students with Disabilities

Designing educational programs for students identified with disabilities, including informal assessment, curriculum modifications, instructional alternatives, and specialized materials and technology. Emphasis is on educational decision-making within a collaborative context involving educators, families, and specialists.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

EDCI 5534:

Applied Theories of Instructional Design

Emphasis is on translating theory to the practice of instructional systems development. Examines the application of foundational theories of instructional design (systems theory, communication theory, learning theories, & instructional theories) to the development of technology-based learning materials. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

EDCI 5544:

Instructional Technology Policy Issues, Planning, and Management

Introduces students to "behind-the-scene" dimensions of instructional technology found in eduational institutions and other public or private workplaces. Examines those issues, policies, and practices which impact heavily upon the life and success of instructional technology innovations in both the public and private sector. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

EDCI 5564:

Topics in Instructional Technology Tools & Methods

Introductory or advanced, project-oriented course which examines software tools used to create and organize data for a variety of media elements such as text, graphics, images, animation, audio and video. Topics also include principles, techniques, and modern practices used to produce and/or deliver interactive, multimedia applications for education, professional training, public information, and retail marketing. May be repeated to a maximum of 9 semester hours. I,II
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture, Online Lecture

EDCI 5584:

Program and Product Evaluation

Applied evaluation concepts and issues based on effective instructional design principles and message presentation guidelines derived from the behavioral and cognitive sciences. Students participate in the summative evaluation of a commercially-produced and implemented instructional program as well as conduct the formative evaluation and review of selected media-supported instructional products. I, II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

EDCI 5594:

Topics in Instructional Design Project Development

This project-oriented course presents various topics which provides students with opportunities to integrate and apply instructional technology theories, principles, practices, and skills in a variety of authentic client-designer settings. This course represents a "clinical" approach to project development in which students will become part of design teams assigned to work with real clients in an effort to produce real instructional solutions. Specific topics and contact times to be announced each semester offered. May be repeated to a maximum of 9 hours. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 5604:

Distance Education

This course will provide an overview of the current trends and relevant issues in the field of distance and distributed learning systems. The planning, development, and implementation of distance learning programs will be examined from student, faculty, and administrative perspectives. A variety of distance teaching technologies will be utilized to demonstrate the possibilities and implications of their use for distance instruction. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 5644:

Trends and Applied Theories in Professional Development

Students will be introduced to the theoretical and practical aspects of

designing, developing, implementing and evaluating professional development programs. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

EDCI 5654:

Supervision of Student Teachers

A special training course for graduate students who supervise student teachers. Focus is on application of general supervisory principles to the student teaching experience. Training is provided in skills needed for the practice of a clinical approach to supervising student teachers. Special attention is given to protocols for serving in a liaison role for the university to the public schools and to alternative procedures for evaluating student teachers.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

EDCI 5674:

Assessing Individual Students' Educational Needs

Examination of the purpose and process for individually assessing students' educational needs. Review of current assessment issues. Analysis of selected screening and diagnostic procedures available to regular and special education teachers. Experience in planning and conducting an individual educational assessment. Formulation of intervention strategies based on assessment findings.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

EDCI 5684:

Crossing the Border Through Service-Learning

Experiential education in the local Latino community through academic readings, community experience, journal reflections, and classroom discussions. Includes 50 hours per semester of interaction with Latino families in their homes, exchanging culture and language with recent immigrants to the New River and Roanoke Valleys. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 5705:

Adv Curriculum & Instruction: Engl, for Lang, Math, Mus, Sci, Soc Studies

The major issues and problems related to the teaching of English, foreign language, mathematics, music, science, or social studies; selective study and analysis of recent curriculum trends and materials; discussion and evaluation of research. Teaching experience required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

EDCI 5706:

Adv Curriculum & Instruction: Engl, for Lang, Math, Mus, Sci, Soc Studies

The major issues and problems related to the teaching of English, foreign language, mathemathics, music, science, or social studies; selective study and analysis of recent curriculum trends and materials; discussion and evaluation of research. Teaching experience required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

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

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

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

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

EDCI 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

EDCI 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

EDCI 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

EDCI 6014:
Advanced Topics in Teacher Education Currilculum
A systematic study of the development and consequences of elementary and secondary schooling in the United States.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

EDCI 6114:

Cognitive Processes and Educational Practice

Investigates complex human learning from the perspective of cognitive/information processing theories. Emphasizes methods of investigation in cognitive science as well as strategies for using a cognitive orientation in educational settings.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 6134:

Topics in Instructional Design

Examination of theory and empirical research applied in modern approaches to instructional design.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 6224:

Constructivism and Education

Philosophical, theoretical, and empirical foundations of the broad field of constructivism, including the limits of epistemology and ontology, the determination of truth and reality, and applications to education and everyday life. Emphasis on radical constructivism, social constructivism, symbolic interactionism, social constructionism, and cognitive constructivism, and their applications to education.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

EDCI 6334:

Multimedia Cognition

Theoretical, empirical and practical foundations of human cognition within multimedia learning environments. Emphasis will be on fostering complex cognition within multimedia environments through the careful design, development and implementation of multimedia instruction.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 6444:

Motivation and Cognition

Explores current research in the field of motivation as it relates to educational settings. Students will learn how motivation constructs relate to student behavior and cognition, how to select approriate strategies to motivate students, and how to design measures to assess student motivation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

EDCI 6554:

Inquiry in Educational Psychology

Analysis of current issues in educational psychology. Focuses on examining current problems and solutions, posing new problems and potential solution strategies, and examining the processes involved in scholarship. Students will develop a research investigation that includes reviewing literature, examining inquiry strategies, and summarizing evidence.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 6604:

Curriculum Theory and Organization

Examination of critical issues in curriculum including definition, theory construction, theories of human nature, structure of knowledge, school organization, and interaction with instruction. Analysis of alternative theories of curriculum in the context of the school, society, and broader theories of education.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 6644:

College Teaching

Teaching/learning process and consideration of teaching methods employed to encourage, guide, and evaluate college students' learning.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 6654:

Research in Instructional Technology

The purpose of this course is to introduce the students of instructional technology to the development and history of research in the field, to generate research principles, to the types of research in the field, and to the current trends in research in the field. Students will be given an opportunity to review and critique a wide range of research and be required to formulate a conceptual idea and complete a literature review of a potential research topic. Post-masters standing required. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

EDCI 6664:

Trends and Practices in Instructional Technology

The utilization of modern instructional media and technologies and their integration with other components of a learning system. The various electronic and computer-assisted technologies will be stressed as will the software support for classroom and individualized instructional modes. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

EDCI 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

EDUCATION, EDUCATIONAL LEADERSHIP AND POLICY STUDIES

Professors: Michael Alexander; Penny Burge; James Craig; Elizabeth Creamer; Joan Hirt; Kusum Singh;

Associate Professors: Nancy Bodenhorn; Pamelia Brott; Mido Chang; Norma Day-Vines; Serge Hein; Steven Janosik; Gerard Lawson; Yasuo Miyazaki; Gary Skaggs; Travis Twiford;

Assistant Professors: Carol Cash; William Glenn; Simone Lambert; Norman Tripp; Laura Welfare;

Affiliated Faculty: Catherine Amelink; Kristine Dahm; Bethany Flora; E Harris; Patricia Hyer; Ellen Plummer; Donna Ratcliffe; Frank Shushok; Edward Spencer;

Emeritus Faculty: Claire Curcio; Glen Earthman; Jimmie Fortune; Hilda Getz; Thomas Hohenshil; Wayne Worner;

General Contact: daisys@vt.edu

Educational Leadership and Policy Studies:

http://www.soe.vt.edu/elps/index.html

The Educational Leadership and Policy Studies departmental unit in the School of Education is chaired by Elizabeth Creamer (creamere@vt.edu, 211 East Eggleston Hall, 540-231-8441). The web site for the unit is: http://www.soe.vt.edu/elps/index.html The departmental unit includes four programs, listed here with the contact information for the program leader and the program web site:Counselor EducationProgram Leader: Nancy Bodenhorn (nanboden@vt.edu, 312 East Eggleston Hall, 540-231-9704)Web site: http://www.soe.vt.edu/counselored/ Educational LeadershipProgram Leader: Wayne Tripp (wtripp@vt.edu, 207 East Eggleston Hall, 540-231-9728)Web site: http://www.elps.vt.edu/EDAD/default.html Educational Research and EvaluationProgram Leader: Penny Burge (burge@vt.edu, 314 East Eggleston Hall, 540-231-9730) Web site: http://www.soe.vt.edu/edre/index.html Higher Education Program Leader: Steve Janosik (sjanosik@vt.edu, 306 East Eggleston Hall, 540-231-9702)Web site: http://www.soe.vt.edu/highered/ The Educational Leadership and Policy Studies degrees are offered by the Educational Leadership and Higher Education programs, and the following information relates to these programs. The Counselor Education and Educational Research and Evaluation programs have separate degree authorizations and are listed separately in the Graduate Catalog.

SPECIAL FACILITIES

DEGREES OFFERED

MA Degree

Offered In (National Capital Region, 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 Educational Leadership and Policy Studies. 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 (National Capital Region, 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 Educational Leadership and Policy Studies. 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 (National Capital Region, 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 Educational Leadership and Policy Studies. 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.

EdS Degree

Offered In (National Capital Region, 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 Educational Leadership and Policy Studies. 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 (ELPS)

ELPS 5004:

School Personnel Administration and Instructional Supervision

Administration and supervision of human resources and instructional programs in schools. Content encompasses human resources planning, recruitment, selection, assignment, induction, supervision and appraisal, development, compensation and benefits, employee relations, and other topics of current interest.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ELPS 5024:

School Law

Federal and state laws governing public education and the legal responsibilities and powers of various state and local governing bodies and individuals. Emphasis given case law, federal and state, affecting such topics as rights of teachers, rights of students, due process, liability, and equal protection.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ELPS 5034:

Public School Finance

Basic policies, principles, and practices involved in solution of problems of public school finance. Meets Virginia certification requirements for the principalship. 1 year or more of teaching experience required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ELPS 5054:

Administration of Special-needs Programs

Basic provisions of federal/state laws, policies, and regulations pertaining to special education, vocational education, and other special-needs client groups of the public schools.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ELPS 5284:

Practicum: College Student Affairs

Supervised on-the-job experiences in settings, such as community colleges and college and university student personnel divisions. Experiences accompanied by regularly scheduled seminars designed to provide positive evaluation and analysis of the field experience. (1-12 C). Must have 20 hours previous course work in the field.

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture, Online Lecture

ELPS 5304:

Student Development in Higher Education

The evolution and current practice of student development in higher education. Analysis of the contemporary college student. Emphasis on philosophical, conceptual, and research foundations for practice and on the organizational contexts of professional practice.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ELPS 5314:

Theory and Appraisal of College Student Development

Theories explaining college student development and change. Cognitive-developmental, psychosocial, person-environment interaction, and humanistic-existential theories are included. Emphasis on late adolescent and adult theories about effects of college on students. Also includes procedures for measuring student development and change.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ELPS 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

ELPS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ELPS 6004:

Theories of Educational Administration

A general course for students of administration in public and private schools, community colleges, four-year colleges, and universities. Content includes purposes and nature of theory in educational

administration and the application of organizational theory to education. Theories of decision making, communication, leadership, climate, power, conflict, change, morale, and motivation are covered.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ELPS 6024:
Public School Budgeting
Policies, principles, and practices involved in the practice of public school budgeting.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ELPS 6034:
Planning Educational Facilities
Basic information needed by administrators to mount an effective planning effort within an organization; to plan, develop, and maintain satisfactory buildings to house modern educational programs; to supervise the work of other professionals and technicians in designing and constructing facilities; and to evaluate such efforts. Meets Virginia requirements for placement on the Eligible List of Division Superintendents.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ELPS 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

ELPS 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

ELPS 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

ELPS 6074:
Higher Education Law
Legal process in higher education. Emphasis on corporate responsibilities, faculty and student rights, tort liability, and accreditation. Analysis of current national and state court decisions affecting higher education.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ELPS 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

ELPS 6094:
Educational Administration Processes and Skills
Emphases on the systematic application of knowledge and theory concerning the process, structure, and tools for administration of school and university systems. Focus on developing administrative skills, including use of strategic and operational concepts for improving decision-making and motivation.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ELPS 6114:
Staffing Practices in Education
A study of human resource management in education. Emphasis will be given to recruitment and selection, induction and orientation, supervision, staff development, and performance appraisal practices at

all levels of education. Doctoral standing or instructor permission is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

ELPS 6204:

Policy Studies in Education

Study of policy-making, policy analysis, and educational reform. Emphasis will be given to the policy-making process, state and federal roles in public education, the role of values and interest groups, policy analysis, equality of educational opportunity, systemic reform and implementation, and politics of education.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ELPS 6214:

State Role in Education

Focuses on acquiring knowledge and understanding of state education public policy formulation and on the role of state government in education. The course will address four major areas: government structures, the processes of policy development at the state level, process of policy implementation, and critical issues in the analysis of implementation strategies and policy effects. All levels of the educational system will be examined (i.e., elementary, secondary, and postsecondary levels, including community colleges).

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

ELPS 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

ELPS 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

EDUCATION, EDUCATIONAL RESEARCH, EVALUATION

Gary Skaggs, Program Director

Professors: Penny Burge; Elizabeth Creamer; Kusum Singh;

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

General Contact: kaprice4@vt.edu

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

The Educational Research and Evaluation (EDRE) program 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. Graduates of the EDRE program are prepared for academic positions as research methodologists, positions in research and testing agencies, institutional research planning and 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, but some courses may be taken at the Northern Virginia campus. Faculty members and students in the program conduct research relating to issues in education, assessment, and other behavioral sciences. Faculty in the program also provide research expertise to faculty members and graduate students in the School of Education by serving as methodology specialists on research projects and doctoral dissertation committees and by teaching courses in the areas of measurement, program evaluation, qualitative research methods, and statistics.Historically, the EDRE program was established in 1971 and was the first Ph.D. program in educational research in the State of Virginia. Over the years, the program has featured a small but high-quality group of students, granting 145 Ph.D.s to date (2010).

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

EDRE 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

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

EDRE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

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

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

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

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

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

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

EDRE 6644:

Advanced Research Design and Methodology

Principles of experimental design with applications to the behavioral sciences emphasizing appropriate statistical analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

EDRE 6764:

Advanced Rasch Measurement

Provides theory and experiences in applying variants of the Rasch model. Theory and practices relating to the use of polytomous, mixture, and multidimensional Rasch models, as well as their application to common measurement problems such as differential item functioning, analysis of rater effects, and parameter estimation will be emphasized.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

EDRE 6774:

Advanced Issues in Psychometric Research

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

EDRE 6914:

Problems in Education

Study of contemporary problems in various education settings such as administration, counseling, community college education, and adult and continuing education. (Maximum 3C per course).

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

EDRE 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

EDRE 6944:

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

EDRE 6974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

EDRE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

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

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

EDRE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ELECTRICAL ENGINEERING

Scott Midkiff, Head

Professors: Peter Athanas; Aloysius Beex; Dushan Boroyevich; Tamal Bose; Robert Broadwater; Gary Brown; C Clauer; William Davis; Dong Ha; Michael Hsiao; Mark Jones; Jih Lai; Fred Lee; Paolo Mattavelli; Scott Midkiff; Lamine Mili; Khai Ngo; Mariusz Orlowski; Paul Plassmann; Ting Chung Poon; Timothy Pratt; Saifur Rahman; Sanjay Raman; Krishnan Ramu; Jeffrey Reed; Sedki Riad; Ahmad Safaai-Jazi; Wayne Scales; William Tranter; Joseph Tront; Yue Wang; Anbo Wang;

Associate Professors: Amos Abbott; Masoud Agah; Scott Bailey; William Baumann; Richard Buehrer; Virgilio Centeno; Jaime De La Reelopez; Steven Ellingson; Louis Guido; Yiwei Hou; Mantu Hudait; Douglas Lindner; Allen MacKenzie; Thomas Martin; Kathleen Meehan; Willem Odendaal; Jung-Min Park; Cameron Patterson; JoAnn Paul; Binoy Ravindran; John Ruohoniemi; Sandeep Shukla; Luiz Silva; Daniel Stilwell; Kwa Sur Tam; Fei Wang; Chris Wyatt; Jianhua Xuan;

Assistant Professors: Joseph Baker; Majid Manteghi; Leyla Nazhandali; Patrick Schaumont; Christopher White; Yong Xu; Yaling Yang; Claudio da Silva;

Bradley Distinguished Professor of Electromagnetics: Gary Brown;

Hugh P and Ethel C Kelly Professor: James Thorp;

Emeritus Faculty: James Armstrong; Ioannis Besieris; Charles Bostian; Richard Conners; Walling Cyre; David De Wolf; Festus Gray; Richard Moose; Charles Nunnally; Arun Phadke; Frederick Stephenson; Warren Stutzman; James Thorp; Hugh Vanlandingham;

Alumni Distinguished Professor: Charles Bostian;

Bradley Professor of Communications: William Tranter;

Willis Worcester Professor: Jeffrey Reed;

University Distinguished Professor: Fred Lee; Arun Phadke;

Clayton Ayre Professor: Anbo Wang;

American Electric Power Professor: Dushan Boroyevich;

Joseph R. Loring Professor: Saifur Rahman;

Thomas L. Phillips Professor: Warren Stutzman;

Graduate Admissions: vt.ece.gradadm@vt.edu

Graduate Counseling: vt.ece.gradadv@vt.edu

NCR Graduate Coordinator: cdrobi@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 525 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 very 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

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

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (96.0)

GRE

General Test: Verbal (500.0), Quantitative (725.0), 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.

Degree Concentrations:

Research Areas

The outstanding ECE faculty is world-renowned for teaching and research. Students can select an area of research from the following Computer Engineering areas available through the Bradley Department of Electrical and Computer Engineering: Communications Electromagnetics Electronics and Circuits Signals, Systems, and Controls Power

MS Degree

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

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (96.0)

GRE

General Test: Verbal (500.0), Quantitative (725.0), Analytical (550.0)

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.

Degree Concentrations:

Research Areas

The outstanding ECE faculty is world-renowned for teaching and research. Students can select an area of research from the following Computer Engineering areas available through the Bradley Department of Electrical and Computer Engineering: Communications Electromagnetics Electronics and Circuits Signals, Systems, and Controls Power

PhD Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (590.0)

Computer: (243.0)

iBT: (96.0)

GRE

General Test: Verbal (500.0), Quantitative (725.0), Writing (4.5)

IELTS

General: Band (7.5)

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.

Degree Concentrations:

Research Areas

The outstanding ECE faculty is world-renowned for teaching and research. Students can select an area of research from the following Computer Engineering areas available through the Bradley Department of Electrical and Computer Engineering: Communications Electromagnetics Electronics and Circuits Signals, Systems, and Controls Power

GRADUATE COURSES (ECE)

ECE 5104:

RF & Microwave Engineering and Applications

A review of basic electromagnetics. Transmission lines, waveguides, microstrip lines, striplines. Microwave networks and impedance matching, Smith chart, S-Matrix, ABCD matrix, transformers. Microwave filters. Active RF components. Microwave amplifier design. Microwave

systems. Microwave Integrated Circuits (MIC). RF Microelectromechanical System (MEMS) components. RF components for wireless systems. RF components for Ultra Wideband (UWB) systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

ECE 5105:

Electromagnetic Waves

Maxwell's electromagnetic field theory and its applications to engineering problems. 5105: Fundamental concepts associated with elementary plane wave theory and boundary value problems with applications to half-space reflection problems; fundamental theorems. 5106: Analytical techniques (Green's theory, modal analysis, integral equations, etc.) applied to setting up, approximating, and solving radiation, unguided, and guided wave propagation, and scattering by medium discontinuities in open and closed geometries. Graduate standing required. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5106:

Electromagnetic Waves

Maxwell's electromagnetic field theory and its applications to engineering problems. 5105: Fundamental concepts associated with elementary plane wave theory and boundary value problems with applications to half-space reflection problems; fundamental theorems. 5106: Analytical techniques (Green's theory, modal analysis, integral equations, etc.) applied to setting up, approximating, and solving radiation, unguided, and guided wave propagation, and scattering by mdeium discontinuities in open and closed geometries. Graduate standing required. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

ECE 5204:

Power Semiconductor Devices

Characteristics, fabrication and application of power semiconductor devices which includes BJT, FET, power diodes, insulated gate and static induction transistors. Device drive requirements and power circuit interaction. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

ECE 5206:

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

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

ECE 5214:

Phase-locked Loops: Theory and Practice

Fundamental theory and design concepts of frequency synchronization techniques. Emphasis is on phase-locked loops and applications in communications for frequency synthesis, tracking, and demodulation. Laboratory investigates fundamental principles of operation with a final project to develop specific aspects of a loop in detail. Alternate year course.
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

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

ECE 5224:

Non-Linear Communication Circuits

Advanced methods of analysis and design of communication circuits with emphasis on nonlinear effects and filtering. Nonlinear device models and their use in the design of oscillators and mixers at HF through UHF frequencies. The design of power amplifiers. I. Alternate years.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ECE 5234:

Emi and Noise Reduction Techniques

Theory and practice of E.M. noise coupling; Techniques for noise reduction: shielding, grounding and filtering. Measurement of EMI to comply with government regulation. EMI problems and solutions to switching power supply applications. Design of EMI filter. I
Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5235G:

ADV Electronic Packaging

Design issues such as electrical, electromagnetic, thermal, mechanical, and thermomechanical, are covered at the lower levels of packaging hierarchy. Materials and process selection guidelines are discussed for the manufacturing and reliability of chip carriers, multichip and hybrid modules. Theoretical bases for design methodology and package reliability. Solid modeling for electrical and thermal designs from chip to board. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5236G:

ADV Electronic Packaging

System-level package design issues to meet application requirements are introduced and modeling tools for analyzing electronic packages are applied. Materials and process selection guidelines are discussed for the manufacturing and reliability of packaged electronic products. Application of theoretical principles to analysis designs. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5240G:

Adv Semiconductor Proc Lab

Design, layout, fabricate, and characterize mircoeletronic devices. Analyze test results to verify performance to the predetermined specifications. Participate on a team project in which they will develop processes used to fabricate more advanced devices and/or circuits. Required oral and written reports. May not be taken if credit has been previously earned for ECE 4244.

Credit Hour(s): 3

Lecture Hour(s): 1

Instruction Type(s): Lab, Lecture

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

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

ECE 5260:

Power Electronics System Integration

A broad overview of advanced power electronics technologies with an emphasis on multi-disciplinary aspects of integrated design. Investigation of relationships between system application requirements and technological challenges in circuit topologies, power semiconductor devices, sensing and control, integrated packaging, and thermal management, and their impact on the system reliability and cost. Introduction to the concept of integrated power electronics modules and their application in distributed power systems and motor drives. The course is organized as a series of seminar lectures jointly taught by leading researchers from several universities and industry, via distance access. P/F only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

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

ECE 5364:

Electric Energy and Environmental Systems

Role of electricity from fossil and nuclear fuels, and renewable resources. Impact of high voltage transmission lines. Health effects of electricity generation. Assessment of cogeneration cycles and demand side management. Emission control in the US electric utility industry. Evaluation of uncertainties in quantifying emissions impacts. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

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

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

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

ECE 5524:
Pattern Recognition
Computational methods for the identification and classification of objects. Feature extraction, feature-space representation, distance and similarity measures, decision rules. Supervised and unsupervised learning. Statistical pattern recognition: multivariate random variables; Bayes and minimum-risk decision theory; probability of error; feature reduction and principal components analysis; parametric and nonparametric methods; clustering; hierarchical systems. Syntactic pattern recognition: review of automata and language theory; shape descriptors; syntactic recognition systems; grammatical inference and learning. Artifical neural networks as recognition systems.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

ECE 5544:
Coding Theory
Use of codes to improve the reliability of transmission over noisy channels. Algebraic structure of codes. Includes error detecting and correcting codes. BCH Codes, Reed Solomon Codes, and convolutional codes and codes for checking arithmetic operations. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

ECE 5546:

Advanced VLSI Design

Advanced concepts in CMOS-based digital system design 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 techniques in the different levels of the design hierarchy (5546) 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

ECE 5550G:

Advanced Real Time Systems

Introduction to real-time systems, real-time scheduling including multiprocessor scheduling, real-time operating systems (kernels), real-time communication, real-time programming languages, reliability and fault-tolerance, and real-time system requirements and design methods. Design, analysis, and implementation of real-time kernel mechanisms and real-time applications using kernels such as Linux and programming languages such as C (with POSIX primitives) and real-time Java. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5554:

The Theory and Design of Computer Vision Systems

Gives a critical examination of current theories of computer vision. Explores both image analysis and scene analysis methods with the emphasis being given to scene analysis techniques. Emphasis is placed on the strategies that can be used rather than upon particular operators. Gives the design trade-offs associated with the various strategies. Draws analogies between computer vision techniques and the operations that are seemingly performed in human vision.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5560 (CS 5560):

Network and Computer Security

Introduces both fundamental security principles as well as real-world applications of network and computer security. Covers a wide range of topics including authorization and access control, basic cryptography, authentication systems, e-commerce security, sensor network security, and legal and ethical issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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 is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

ECE 5566 (SOC 5214) (PAPA 5214) (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

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

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

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

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

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

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

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

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

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

ECE 5635:

Radar Systems Analysis and Design

5635: Theory and practice of radar systems used for detection, tracking, and location of targets. Covers measurement of range and velocity, pulse compression, design of radar transmitters, receivers, and antennas. 5636: Performance analysis of modern radar signal processing techniques. Topics include radar signal detection theory and optimal receiver analysis, target parameter estimation, pulse compression techniques, clutter reduction, and tracking. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5636:

Radar Systems Analysis and Design

5635: Theory and practice of radar systems used for detection, tracking, and location of targets. Covers measurement of range and velocity, pulse compression, design of radar transmitters, receivers, and antennas. 5636: Performance analysis of modern radar signal processing techniques. Topics include radar signal detection theory and optimal receiver analysis, target parameter estimation, pulse compression techniques, clutter reduction, and tracking. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 5655:

Communication System Design

5655: Physical concepts and practical topics providing tools to calculate carrier-to-noise ratio in communication systems are discussed, including: noise processes, polarization topics, atmospheric propagation, receiver components, antennas, system calculation, and case studies. 5656: Advanced topics in digital satellite communications are discussed. These include multiple access, digital modulation, error correction coding, carrier phase, and symbol timing recovery. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5656:

Communication System Design

5655: Physical concepts and practical topics providing tools to calculate carrier-to-noise ratio in communication systems are discussed, including: noise processes, polarization topics, atmospheric propagation, receiver components, antennas, system calculation, and case studies. 5656: Advanced topics in digital satellite communications are discussed. These include multiple access, digital modulation, error correction coding, carrier phase, and symbol timing recovery. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 5664:

Cellular Radio and Personal Communications

Fundamental theory and design of high capacity wireless communications systems. Topics include trunking, propagation, frequency reuse, modulation, coding, and equalization. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ECE 5724:

Neural and Fuzzy Systems

Introduction to various structures of artificial neural networks and fuzzy logic systems, as well as special learning mechanisms such as generalized back-propagation, clustering and genetic algorithms. Applications will be made to classification problems, binary associative memories, self-organizing maps, and nonlinear system modeling and control including on-line adaptation. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5744 (ME 5544) (AOE 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

ECE 5754 (ME 5554) (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

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

ECE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

ECE 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ECE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ECE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

ECE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

ECE 6314:

Microcomputer Applications in Power Systems

Role of microcomputers in monitoring, control, and protection of power equipment and networks. Hierarchical computer systems. Protection algorithms. Protection of line, transformers, and buses with microcomputers. Real time phasor measurements. Measurement of frequency. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 6364:

Smart Grid Design & Operation

Introduction to smart grid technologies. Operating principles and models of smart grid components, including distributed energy sources and distribution feeder components. Communication infrastructure for smart grid operation. Advanced metering infrastructure and advanced control methods. Demand response and demand management. Distribution feeder analysis. Impact of smart grid component integration on distribution network operation. Smart grid reliability evaluation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ECE 6444:

Advanced Topics in Controls

Advanced topics of current interest in control theory taken from current research topics or technical publications. Graduate standing required. May be repeated.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

ECE 6514:

Applications of Automata Theory to Digital Design

Applications of theory of finite automata, push-down automata, and

Turing machines to the design of digital machines. Emphasis will be on the computational capabilities of classes of finite and infinite automata and on the consequences for digital design. Theory of NP-completeness, description of NP complete problems in digital design, and the consequences for design processes. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

ECE 6624:
Spectral Estimation & Modeling
An advanced introduction to the processing and modeling of random discrete-time signals. Random time series, auto- and cross-correlation sequences and their generation, filtering of random sequences, Wiener filters, matched filters, modeling assumption errors, one-step predictors, rational modeling of random sequences, parametric and non- parametric spectral estimation. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

ECE 6774 (AOE 6774) (BMVS 5454) (ME 6574) (VM 8034):
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

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

ECE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENGINEERING EDUCATION

Stephanie Adams, Head

Professors: Vinod Lohani; Janis Terpenny; Bevlee Watford;

Associate Professors: Maura Borrego; Richard Goff; Marie Paretti;

Assistant Professors: Aditya Johri; Holly Matusovich; Elizabeth McNair; Christopher Williams;

Graduate Program Contact: whoskins@vt.edu

Graduate Site: http://www.enge.vt.edu/Graduate/grad.html

Graduate Student Manual: http://www.enge.vt.edu/Graduate/EngE%20graduate%20manual%2011-12.pdf

The Engineering Education PhD. program incorporates theory with real life application so that its students are prepared to be teachers and scholars in the emerging field of engineering education. 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 12-credit graduate certificate. Course offerings overlap significantly with those of the Ph.D.

SPECIAL FACILITIES

The Department of Engineering Education has cultivated core research strengths in professional skills (interdisciplinarity, communication, cross-cultural competence) design education, and first- year courses (particularly learning technology). Retention, diversity, and assessment are important foundational concepts in the field of engineering education; as such, they are elements of all our projects.

LabVIEW Enabled Watershed Assessment System Lab (LEWAS)

Supported by the National Science Foundation and with guidance from faculty advisor Dr. Vinod Lohani, the lab teaches environmental sustainability to freshmen engineering students using an impaired on-campus stream. This is facilitated by utilizing real-time water quality monitoring of a local watershed. Students are expected to recognize the application of dataflow programming in acquiring, transmitting, and analyzing water quality data.Dr. Vinod Lohani, Director

NSF Center for e-Design

The Center for e-Design is a joint research collaborative consisting of five universities - Virginia Tech, University of Pittsburgh, University of Massachusetts - Amherst, University of Central Florida, and Carnegie Mellon University.In collaboration with several government and industry agencies, their objective is to create new design paradigms and electronic design tools that will assist in generating high quality products and systems at a reduced cot while also reducing the time associated with designing complex engineered products and systems.Dr. Janis Terpenny, Director.

Systems Modeling and Realization Lab (SMART Lab)

The SMART Lab combines engineering design and information technology. A systems oriented approach is applied to provide designers, particularly of complex systems and products, with methods and tools that allow for ease of modeling coupled with rigorous methods for design synthesis and evaluation from a life-cycle perspective. Knowledge management, function-based design representation, and solution synthesis methods that consider preference, imprecise information and multi-attribute decision-making are integral to current projects.Dr. Janis Terpenny, Director

Technology, Open Organizing, & Learning Sciences Laboratory (toolsLAB)

Led by Engineering Education Assistant Professor Aditya Johri toolsLAB studies digital tools and their impact on developing new ways of knowledge building and knowledge sharing and their influence on learning and work practices. Dr. Aditya Johri, Director

Virginia Tech Engineering Communications Center (VTECC)

Through research, instructional support, and assessment, the VTECC fosters partnerships among faculty, industry, and students to operationalize professional skills in engineering. VTECC is a forum for raising the global professionalism of students, supporting faculty who integrate communication into their courses, and contributing to student retention efforts. This facility is currently building a national center for collaborative research dedicated to determining the best methods of teaching communication skills in school and implementing effective communication practices in the workplace.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

Ph.D. students must take a minimum of 90 total credits beyond the Bachelor's degree, submitted on a program of study subject to approval by student's advisory committee. Curricular Requirements: Dissertation: 30 credits min. Statistics: 6 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 Ph.D. 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 Ph.D. at the discretion of the student's advisory committee. Students must enroll in ENGE 5704: Engineering Education Graduate Seminar (1 cr) each semester. Course does not count toward degree. 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

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

ENGE 5204:

Design of Laboratory Courses for Engineering Education

This course is intended to expand the graduate student's competence in teaching, learning, and functioning in an experimental laboratory environment. Topics span the value of the lab experience and basic experimental concepts to genres of communication for lab results and a survey of techniques for measuring a broad range of physical quantities. This class will provide the foundational knowledge needed to design undergraduate engineering laboratory courses and will improve student proficiency in experimental graduate research. Graduate standing and B.S. in a physical science or engineering discipline required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGE 5304:

Communication in Engineering Curricula: Theory, Practice, and Pedagogy

Pedagogical theory and practice for incorporating communication skills in engineering courses. History of communication instruction in the disciplines; the current research on workplace communication; and theories of student learning in writing and speaking. Theoretical and practical approaches to assessment, especially creating and maintaining a cycle of continual improvement between learning objectives, instruction, and assessment in written and oral communication. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGE 5334:

Evaluating Engineering Communication Assignments

Explore a variety of applicable strategies they can use to help engineering students in their courses become stronger communicators. Topics include developing concrete criteria for evaluating, identifying weaknesses, deciding where and how to intervene, developing effective written and oral responses to help students improve, and locating additional resources to help engineering student communication. Graduate standing in an engineering department at Virginia Tech required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

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

ENGE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ENGE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

Instruction Type(s): Lecture, Online Lecture

ENGE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENGE 6604:

Advanced Engineering Research Methods

This course focuses on research issues and methods specific to engineering disciplines, including engineering education. Quantitative, qualitative, experimental, and theoretical research methods are discussed as well as reliability, validity, and other measures of quality. Students will learn to design and critique engineering research in their disciplines and have the opportunity to write an original research proposal, with literature review, consistent with departmental requirements. Collaboration and variations in disciplinary standards are also discussed.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

ENGE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENGINEERING MECHANICS

Ishwar Puri, Head

Professors: Hassan Aref; Romesh Batra; Mark Cramer; David Dillard; Norman Dowling; John Duke; John Grant; Muhammad Hajj; Luther Kraige; John Lesko; Roop Mahajan; Ishwar Puri; Saad Ragab; Mahendra Singh;

Associate Professors: Marwan Al-Haik; Scott Case; Scott Hendricks; Ronald Kriz; Michael Madigan; Marie Paretti; Mark Stremler; Surot Thangjitham;

Assistant Professors: Raffaella De Vita; Shane Ross; John Socha; Anne Staples;

Emeritus Faculty: Robert Heller; Edmund Henneke; Michael Hyer; Robert Jones; Leonard Meirovitch; Dean Mook; Don Morris; Ali Nayfeh; Kenneth Reifsnider; Daniel Schneck; Charles Smith; Demetri Telionis; Henry Tieleman;

Reynolds Metals: Hassan Aref;

Clifton C. Garvin: Romesh Batra;

Adhesive & Sealant Science: David Dillard;

W.S. White: Scott Hendricks;

N. Waldo Harrison: Michael Hyer;

Tucker Chair: Roop Mahajan;

University Distinguished: Ali Nayfeh;

Preston Wade: Mahendra Singh;

Frank J. Maher: Demetri Telionis;

Graduate Contact: lisas@vt.edu

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

The Department of Engineering Science and Mechanics provides a strong foundation and a 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 methods. The department 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 ESM 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, ESM 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 ESM Dpartment has allocated ~ 40,000 sq ft. for the following laboratories: Adhesion Mechanics Laboratory Biologically Inspired Fluid Laboratory Biomechanics Laboratory Cardiovascular Hemodynamics Laboratory Comparative Biomechanics Laboratory Composite Fabrication Laboratory Creep Laboratory Damage Science and Mechanics Laboratory Fluid Mechanics Laboratory Georgia Pacific Adhesion Science Laboratory Kevin P. Granata Biomechanics Laboratory Laboratory for Scientific Visual Analysis Mechanics of Soft Biological System Laboratory Multi-Phase Flow LaboratoryMultiphysics Research Group Nonlinear/Dynamic/Vibration Research LaboratoryServohydraulic Laboratory

Adhesion Mechanics Laboratory

Mechanical, electrical, and optical techniques are employed to characterize adhesives and determine performance of adhesively bonded joints and structures. Fracture mechanics principles are widely used to better understand joint capabilities. Special equipment includes a 10,000 lb. MTS servohydraulic test frame used for fatigue testing, a 20,000 lb. Instron test frame with an assortment of load cells for conducting strength and fracture tests, two drop towers for impact studies, a high speed camera, an environmental chamber for use in the load frames, a Nikon microscope, a micromanipulator used for testing coating adhesion, a Veeco interferometric profilometer, and computers and work stations used for finite element analysis.

Biologically Inspired Fluid Laboratory

Major experimental equipment in the laboratory include: A high-speed camera (Redlake N3) Programmable a linear stage (Velmex, Xslide) to actuate the linear motion. Its maximum load is 2.3 kg with the accuracy of a 0.001-inch resolution A high resolution digital camera (Canon 50D) Inverted Microscope (Leica)

Biomechanics Laboratory

Microscopes, micromanipulation systems, and microsurgery, all mounted on a vibration isolation table for making microscopic force and displacement measurements in the vestibular system of the inner ear. Micropitette and Microforge manufacturing capability. Hematology microscope and blood examination equipment. Implantable blood flow measurement equipment. Blood viscosity measurement. Silicon Graphic Indigo 2 work station with associated software to carry out FEA analysis along with several personal computers.

Cardiovascular Hemodynamics Laboratory

Contact: Professor Demetri Telionis Phone: (540) 231-7492

Comparative Biomechanics Laboratory

Major experimental equipment in the laboratory include: Fluorescent Dissecting Microscope Custom Built Dynamic Mechanical Analyzers Fume Hood Distilled Water

Composites Fabrication Laboratory

The Composites Fabrication Laboratory provides the following equipment for processing composite materials: Seventy five ton cauum hot press with eighteen inch by eighteen inch steel patens of temperatures to 800 degrees F. One hundred ton compression hot press. Fifty ton hydraulic compression hot press with sixteen inch by sixteen inch platens. Twenty five ton pneumatic compression hot press with sixteen inch by sixteen inch platens. Clean room facility for composite processing. Fume hood. Large Bally walk in freezer for material storage. K. O. Lee slicer wet saw unit. A variety of steel modls for processing composite materials.

Creep Laboratory

This laboratory contains several lever-arm creep frames, a four-station stepper motor creep frame, and a 72-station pneumatic creep frame. Each is equipped with an oven for conducting tests at elevated temperatures. These units are used to measure the time dependent response of polymeric materials, including adhesives, adhesively bonded joints, and composites. Effects of time, temperature, and stress level are collected for creep, relaxation, and creep rupture loading situations.

Damage Science and Mechanics Laboratory

Damage science and mechanics is concerned with understanding what causes damage, how it develops, and how to evaluate the effects it will have on performance of components. Understanding damage and its effects is an essential element of sustainment of critical structures and systems. In our DSM Lab at Virginia Tech, we focus our efforts on developing methods for detecting and monitoring damage to support the development of models for predicting performance of degraded components or for input to fully developed models used for prognosis or maintenance decision-making. Areas of emphasis at present include damage development prior to macro crack formation in metal alloys and service-induced damage development in advanced composite materials.

Fluid Mechanics Laboratory

This lab contains a water tunnel, a wind tunnel and a towing tank. Such facilities are used to test wing sections, hydrofoils, ship hulls and other devices employed in fluid machinery. Laser-Doppler velocimeters, hot wire anemometers and pressure transducers are among the instruments employed.

Georgia Pacific Adhesion Science Laboratory

A complete thermal analysis system is used to measure the effects of temperature on polymer behavior. Modern TA Instruments units include a modulated DSC (differential scanning calorimeter), DMA (dynamic mechanical analyzer), and modulated TGA (thermogravimetric analyzer). Conditioning chambers for looking at the effects of environment on polymer and adhesively bonded joint performance are also located in this area. A fume hood, refrigerator, centrifuge, vacuum system, and several ovens are used for processing, bonding, and curing specimens.

Kevin P. Granata Biomechanics Laboratory

Our mission is to investigate the dynamics and neuromuscular control of human movement, and to train scientists to become leaders in the field of musculoskeletal biomechanics.

Laboratory for Scientific Visual Analysis

Contact Ron Kriz, Lab Director at: rkriz@vt.edu for further information.

Mechanics of Soft Biological System Laboratory

Major experimental equipment in the laboratory include: Instron ElectroPuls dynamical test system (dynamic capacity= 225 lbf and static capacity= 160 lbf). Photron Ultima APX-RS camera, frame rate: 60 to 250,000 fps, basic resolution: 1024 x 1024 at 3000 fps Zeiss Stereoscope Stemi 2000C Maytag Refrigerator Nikon Camera D500 Various dissecting tools, micrometers, lenses, a digital camera, etc.

Multi-Phase Flow Laboratory

Contact: Professor Demetri Telionis Phone: (540) 231-7492

Multiphysics Research Group

The Multiphysics Research Group (MuRG) investigates transport phenomena and reaction chemistry at the nano, micro and continuum scales using both numerical and experimental methods. The group specializes in techniques such as lattice Boltzmann method, Molecular Dynamics, Stokesian Particle Dynamics amongst others. In addition to theoretical and numerical studies, the group also characterizes materials experimentally using advanced diagnostics such as the Scanning Electron Microscopy, Transmission Electron Microscopy, X-ray Photoelectron Spectroscopy and Laser Induced Fluorescence, to name a few. Current research focuses on microscale mixing using field effects (eg. magnetic or electroosmotic forces), growth models for carbon nanotubes and their characterization, mass and ion transport through carbon nanotubes and heat transfer at the nanoscale. Efforts such as these are indispensable for the advancement of research and development at the frontier of science.

Nonlinear Dynamics/Vibration Research Laboratory

Ling Dynamic Systems 1000-lb reaction-mass shaker Unholtz-Dickie 250-lb table shaker MB Dynamics 50-lb and 100-lb modal shakers MOOG six degrees-of-freedom testing platform DADS mechanical simulation software dSPACE digital control platform Hewlett-Packard 3562A and 35670A multi-channel signal analyzers LabVIEW data acquisition softwareÂ PCB accelerometers and impact hammers Vishay-Measurements Group strain gages and signal conditioners

Servohydraulic Material Testing Laboratory

The Servohydraulic Materials Testing Laboratory, located in 107 Hancock Hall, on the Virginia Tech campus in Blacksburg, Virginia, consists of nine hydraulically-operated load frames which are under the direction of four different departments within the College of Engineering, one research center within the department of Mechanical Engineering, and one research group within the department of Engineering Science and Mechanics. They are the departments of Engineering Science and

Mechanics (ESM), Materials Science and Engineering (MSE), Mechanical Engineering (ME), and Aerospace and Ocean Engineering (AOE), the Center for Intelligent Material Systems and Structures (CIMSS), and the Materials Response Group (MRG). In addition, the U.S.A.F. at Wright-Patterson A.F.B. is temporarily utilizing laboratory space for one of their proprietary testing machines, making this laboratory an interdisciplinary materials testing facility.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0), (0.0)

MS thesis option : student must take 21-24 course credit hours and 6-9 thesis credit hours for a minimum total of 30 credit hours. MS non-thesis option : student must take 30 course credit hours and a final oral examination.

MEng Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

MEng option: student must take 27 credit hours and a three-credit paper on an engineering project.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

Ph.D. : student must take 44-55 course credit hours 36-45 research and dissertation credit hours for a minimum total of 90 credit hours. Student must pass qualifying, preliminary and dissertation proposal and defense exams.

GRADUATE COURSES (ESM)

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

ESM 5064 (AOE 5064):

Structural Optimization

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ESM 5074:

Mechanics of Laminated Composite Structures

Constitutive relations. Classical laminated composite beams, plates, and shells. Theories and boundary conditions. Boundary value problems and solutions for static loads, buckling, and vibrations. Higher ordered theories including shearing deformation and normal stress. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

ESM 5174 (PSCI 5214) (CHEM 5174) (GIA 5214):

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

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

ESM 5234:

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

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

ESM 5304 (HNFE 5694) (PHS 5044) (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

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

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

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

ESM 5324:

Random Vibrations in Structures I

Stationary and nonstationary random processes in random vibrations of structures; ergodicity and measurements of random loads, FFT, autocorrelation and power spectral density functions; response functions; vibrations of single- and multi-degrees of freedom mechanical and structural systems subjected to random loads; response threshold crossing rates, peak distributions, and first passage problem; application to cumulative damage potential and structural reliability assessments. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

ESM 5354:

Mathematical Modeling of Biological Dynamics

This multidisciplinary course focuses on how mathematical models of biological systems can be developed and how the response of these systems to stimuli and aberrations can be studied. The courses discusses various biological subjects, e.g., drug inhibition, population dynamics and epidemiology using biological models. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

ESM 5454 (AOE 5054) (CEE 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

ESM 5464 (PSCI 5484) (CEE 5464) (GIA 5484):
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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

ESM 5654:
Adhesion Science
Introduction to basic principles of adhesion science from the areas of mechanics, materials, and chemistry. Consent required. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ESM 5725:
Mathematical Methods in Engineering I,ii
Linear algebra and matrix theory, vector calculus, complex variables and integral transforms, ordinary and partial differential equations, special functions, integral equations and calculus of variations. Facility with an existing math software package of senior level engineering mathematics required. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

ESM 5726:
Mathematical Methods in Engineering I,ii
Linear algebra and matrix theory, vector calculus, complex variables and integral transforms, ordinary and partial differential equations, special functions, integral equations and calculus of variations. Facility with an existing math software package of senior level engineering mathematics required. I,II
Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

ESM 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

ESM 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ESM 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ESM 5944:

Seminar

Discussion of current research topics in Mechanics 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 Mechanics.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

ESM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ESM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ESM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ESM 6014:

Nonlinear Elasticity

Formulation and study of the equations of nonlinear elastic solids with application to bars, beams, plane elasticity, and plates. Updated and total Lagrangian incremental formulations using virtual work principles. Constitutive equations for compressible and incompressible solids. Analytical solution of some nonlinear problems. Nonuniqueness of solutions. Solution of the nonlinear equations by the Ritz, Galerkin and numerical methods. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ESM 6104:

Mechanics of Composite Strength and Life

Study of the mechanics associated with the description and prediction of the strength and life of composite materials and structures. Mechanistic, phenomenological, and analytical examination of strength and stability concepts for various reinforcement configurations. Effect of damage accumulation; micro-mechanics, damage mechanics, life prediction concepts and methods. Experimental investigative methods. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ESM 6154:

Analysis of Composite Materials

3-D anisotropic constitutive theory, anisotropic elasticity, interlaminar stresses and edge effects, hygro-thermal stress analysis, failure, composite micro-mechanics, effective properties, heat conduction and moisture diffusion.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ESM 6304:

Advanced Vibrations

Hamilton's principle and Lagrange's equations. Vibration of discrete systems; the algebraic eigenvalue problem. Vibration of distributed systems; the differential eigenvalue problem; approximate methods; the finite element method. Substructure synthesis. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

ESM 6974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ESM 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ESM 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENGLISH

Joseph Eska, Chair

Professors: Linda Anderson; Frederick D'Aguiar; Joseph Eska; Edward Falco; Virginia Fowler; Thomas Gardner; Diana George; Nikki Giovanni; Peter Graham; Bernice Hausman; Christine Kiebuzinska; Daniel Mosser; Fritz Oehlschlaeger; David Radcliffe; Lucinda Roy; Carolyn Rude; Robert Siegle; Paul Sorrentino; Ernest Sullivan;

Associate Professors: Kelly Belanger; Eva Brumberger; Sheila Carter-Tod; Anthony Colaianne; James Collier; Clare Dannenberg; Shelli Fowler; Paul Heilker; Robert Hicok; Shoshana Knapp; Jeffrey Mann; Nancy Metz; Katrina Powell; Steven Salaita; Karen Swenson; Dennis Welch;

Assistant Professors: Gena Chandler; Carlos Evia; Julian Koslow; Erika Meitner; Kelly Pender;

Visiting Faculty: Charlene Eska; Elizabeth Mazzolini;

Affiliated Faculty: James Dubinsky; Susan Hagedorn;

University Distinguished Professor: Nikki Giovanni;

Alumni Distinguished Professor: Lucinda Roy;

NationsBank Clifford A. Cutchins III Professor: Paul Sorrentino;

Edward S. Diggs Professor of English: Ernest Sullivan;

Gloria D. Smith Professor of Africana Studies: Frederick D'Aguiar;

Graduate Contact: dmosser@vt.edu

Graduate Contact: sallyw@vt.edu

Graduate Site: http://www.english.vt.edu/graduate/MA/index.html

The MA program at Virginia Tech is focused on the theoretical and practical aspects of evaluating texts and analyzing language in all its aspects. Special attention is paid to the critique and production of digital discourse. Our graduates typically 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 industry.

SPECIAL FACILITIES

Center for the Study of Rhetoric in Society: http://www.rhetoric.english.vt.edu/index.html Linguistics Speech Lab: Contact Clare Dannenberg <cjdannen@vt.edu>

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

The degree requires 36 hours of coursework. All students must take three required courses in Literary Research (5014), Critical Theory (5024), and Digital Humanities (5074). 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 with a Graduate Teaching Assistantship must also take the following pedagogically-oriented courses: ENGL 5004 Theory and Practice in University Writing Instruction (6 credits); GRAD 5004 GTA Training Workshop (1 credit); and GRAD 5124 Library Research Skills-English (1 credit).http://www.english.vt.edu/graduate/MA/policies_procedures.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

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

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

ENGL 5034:

Practicum

Practical training in teaching composition at the university level. Required of all Graduate Teaching Assistants in English. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5054:

Composition Pedagogy

Study of the theory, research, and practice of teaching composition at the university level, including the integration of written, oral, and visual literacies and the uses of technology. Careful consideration of the epistemological and cultural implications of writing instruction. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. P/F only 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

ENGL 5094:

Collab Research Practicum

Practical training in collaborative research practices in discourse analysis, ethnography, historical investigation and other subjects at the graduate level. Pass/Fail only Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5104:

Writing Proj Invitational Inst

Study of the theory, research, and practices of teaching, writing and educational leadership for participants selected for the National Writing Project. Introduction to research methods and overview of current research Composition. Study of collaborative learning theory and participation in an intensive writing workshop. Production of a substantial and varied portfolio of personal and professional texts. Pre-Requisite: Graduate Standing required.

Credit Hour(s): 6

Lecture Hour(s): 6

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II,III,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5134:

Studies in Eighteenth-century Literature

Rotating studies in English Literature of the eighteenth century, focusing on literary traditions, themes, or representative writers. Content will vary; may be repeated once for credit. I,II,III,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5144:

Studies in Nineteenth-century English Literature

Rotating studies in English literature of the nineteenth century, focusing on literary traditions, genres, themes, or representative writers. Contents will vary; may be repeated once for credit. I,II,III,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5154:

Studies in American Literature Before 1900

Rotating studies in American literature before 1900, focusing on literary traditions, themes, or representative writers. Content will vary; may be repeated once for credit. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5174:

Studies in Twentieth-century Texts

Rotating studies in twentieth century literature in English. Typically, the course will concentrate on a kind of writing, a movement, a theme, or a critical issue. Content will vary; may be repeated once for credit. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II,III,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II,III,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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. I,II,III,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II,III,IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5534:

Studies in Literary History

Rotating studies in literary history. Topics, periods, and approaches will vary; may be repeated once for credit.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ENGL 5634:

Writing and Publishing in Electronic Environments

Examination of the ongoing evolution of rhetoric and writing as a technology-supported field. Prepares graduate students to analyze and solve design problems related to rhetorical delivery and content management in digital and online contexts. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5644:

Genres of Professional Practice

Variable topics in genres of professional practice, such as reports, proposals, manuals, and websites; includes study of the genre in use as well as development of an example of the genre. May be repeated twice for credit when the topic varies for a total of nine credits. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s):

Instruction Type(s): Lecture, Online Lecture

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

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

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5754:

Form and Theory of Drama

A graduate course for practicing playwrights and writers in which students are taught to analyze the forms and theories which underlie contemporary playwriting. 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 playwriting and performance. Special emphasis will be placed on the interplay between theory and performance, and the influence of aesthetics on dramatic form and performance practices as students learn to adapt those approaches to their own playwriting.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 5764:

New Media Creative Writing

A graduate course in creative writing in a digital environment, which provides the experienced creative writer with an opportunity to develop a hypertext project. Students will learn a variety of techniques appropriate for writing designed to be read in a digital environment and adapt them to their own texts. Primary focus is on the composition of an original

hypertext, but students are also required to analyze the work of influential "new media" writers and critics of the hypertext genre.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

ENGL 5954:
Study Abroad
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

ENGL 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

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

ENGL 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

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

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

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

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

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

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

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

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

ENGL 6554:

Composition Studies

Studies in the history, topics, sites of practice, and major figures of Composition. 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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ENGL 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENTOMOLOGY

Loke Kok, Head

Professors: David Herbert; Loke Kok; Douglas Pfeiffer; Scott Salom; Peter Schultz; Joseph Voshell; Michael Weaver; Roger Youngman;

Associate Professors: James Bergh; Carlyle Brewster; Thomas Kuhar; Dini Miller; Sally Paulson;

Assistant Professors: Zachary Adelman; Kevin Myles; Igor Sharakhov;

General Contact: kshelor@vt.edu

Student Handbook: http://web.ento.vt.edu/ento/images/graduate_handbook.pdf

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 with additional on-campus laboratory facilities located in Latham Hall and the Fralin Biotechnology building. 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

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

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 (MSLS)M.S. 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 M.S., 20 credit hours of course work and 10 credit hours of research are required. For a non-thesis M.S., 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, M.S. students will receive an MSLFS in Life Sciences 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 M.S. student will complete the course requirements outlined in the Graduate Policies and Procedures and Course Catalog and those described above for M.S. candidates in this department. They will have a Major Professor and Advisory Committee similar to those of other M.S. 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 Ph.D. The department also participates in the college on-line MSLS degree programPh.D. ProgramSuccessful completion of a thesis-based M.S. in entomology or related field is required for admission to the Ph.D. program. Ph.D. 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 Ph.D. 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.

MSLFS Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

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 (MSLS)M.S. 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 M.S., 20 credit hours of course work and 10 credit hours of research are required. For a non-thesis M.S., 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, M.S. students will receive an MSLFS in Life Sciences 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 M.S. student will complete the course requirements outlined in the Graduate Policies and Procedures and Course Catalog and those described above for M.S. candidates in this department. They will have a Major Professor and Advisory Committee similar to those of other M.S. 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 Ph.D. The department also participates in the college on-line MSLS degree programPh.D. ProgramSuccessful completion of a thesis-based M.S. in entomology or related field is required for admission to the Ph.D. program. Ph.D. 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 Ph.D. 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

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

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

ENT 5224:

Field & Laboratory Methods in Vector-Borne Disease Research

An in-depth examination of techniques currently employed to study vectors of human disease, as well as the pathogens they transmit. Topics include: vector sampling methods; vector competence; recombinant virus infectious clone technology and uses; isolation of pathogens from field vector populations; development and uses of transgenic vectors; GIS, remote sensing, and landscape analysis in vector surveillance; as well as arbovirus containment issues related to biosafety level 2 and 3 situations. Graduate standing required.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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

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

ENT 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

ENT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ENT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 0 TO 10

Instruction Type(s): Lab, Lecture

ENT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

ENT 6354:

Insect Behavior

An examination of insect behavior using a comparative evolutionary approach. Topics covered include insect neurophysiology and neuroendocrinology as they relate to insect behavior, feeding and foraging behaviors, zoosemiotics and the evolution of insect communication systems, reproductive behaviors, insect social behavior, defensive behaviors, and thermoregulation. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

ENT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 0 TO 10

Instruction Type(s): Lab, Lecture

ENT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENVIRONMENTAL DESIGN AND PLANNING

Patrick Miller, Head

Graduate Contact: cmattsso@vt.edu

Student Handbook: http://www.caus.vt.edu/CAUS/EDP/

Thank you for your interest in the Environmental Design and Planning program at the College of Architecture and Urban Studies at Virginia Tech. There have been some changes within the College of Architecture and Urban Studies, with the Environmental Design and Planning Ph.D. program being phased out, two new Ph. D programs have been approved, in Architecture and Design Research and in Government and International Affairs. The only new students admitted to the Ph.D. program in Environmental Design and Planning are those interested in Construction and Building Science. Others should apply to one of the new programs that can be linked to from the below descriptions.If you are interested in Architecture and Design Research, including Landscape Architecture, please go to the School of Architecture Design's Web site http://archdesign.vt.edu/architecture-design/phd, from there you can access the Graduate School and apply directly to the ADR (Architecture Design Research) PhD Program. If you are interested in Urban Affairs and Planning or Government and International Affairs please go to the School of Public and International Affairs Web site http://www.spia.vt.edu/PhDinPGG.html, from there you can access the Graduate School and apply directly to the PGG (Planning Governance and Globalization) PhD programIf you are interested in Construction Building Sciences you may still apply to the EDP program. For information on the Myers Lawson School of Construction and the department of Building Construction please visit their web-site at http://www.mlsoc.vt.edu/ and http://www.bc.vt.edu/ You can find the application information at this address http://www.grads.vt.edu/admissions/applying/index.html and http://www.caus.vt.edu/CAUS/EDP/.The college has a diverse faculty with a wide range of expertise. Students in the program have a variety of opportunities to conduct research in one or more of the fields of interest. The program has five streams in which students can pursue focused research. The streams are Architecture, Planning, Construction and Building Science, Public International Affairs, and Design. There are also opportunities for students to pursue multidisciplinary research within or across the streams. Areas of special opportunity for research currently include (but are not limited to): disadvantaged households within metropolitan settings; economic development; energy and environmental policy/planning evaluation and control of indoor environments; evaluation research; health policy/planning; housing policy/planning; integrated land resource surveys; landscape aesthetics and design theory; land use in Latin American historic districts; public management's; construction management processes and materials; IT in construction; residential construction; sustainable Third World development; theory and history of architecture; representation and architecture; and virtual environments technology and applications. Prospective students are encouraged to contact the Director, Stream Coordinators or college faculty with questions related to the program. Special facilities in Blacksburg include a 9,000 square foot research facility, an Environmental Systems Laboratory, and a fully equipped multimedia laboratory (shared with the College of Engineering). The college also operates the Washington-Alexandria Architecture Center in Northern Virginia and participates in the university's Center for European Studies and Architecture in Switzerland. Two streams of the Environmental Design and planning, namely Architecture and Planning offer programs of study at the Washington-Alexandria Center.The Ph.D program in Environmental Design and Planning attracts students with widely differing backgrounds and interests. In order to accommodate this diversity, curriculum requirements are defined in five streams. The streams are: Planning Public and International Affairs Architecture Design Construction and Building ScienceOn entry into the program, students typically follow the requirements associated with one or the other of the five streams. For those wishing to pursue research interest that crosses streams the program committee may propose a combined set of requirements in writing for approval.It is recommended that all students, whether on assistantship or not, complete the TA Training Workshop which is offered for credit and at no charge by the Graduate School in the week preceding the start of each fall semester. Students are expected to arrive early enough to take the workshop at the beginning of their first year.

SPECIAL FACILITIES

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (650.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal, Quantitative, Analytical

Degree Requirements: All students, regardless of stream, are required to complete the Seminar in Environmental Design and Planning. This year-long (two semester) sequence focuses primarily on epistemology and the nature of research, viewed in the context of the architecture, construction, design and planning fields; it also addresses the needs of the "future professorate." Incorporated into the seminar is a research colloquium at which EDP students and others present their own research for critical review and feedback.The overall program of study is selected in collaboration with (and requires the approval of) a faculty advisory committee composed of at least five members, including: (i) the students major professor (from within the College of Architecture and Urban Studies) as chair (ii) at least three members from within the College: and (iii) at least four faculty persons (total) from within the university. The program of study must also be approved by the program committee and by the Graduate School. At least once during the student's first year, and at intervals not exceeding six months thereafter, the advisory committee meets collectively (normally with the student present) to review the student's progress and to prepare a written report for submission to the director. It should be emphasized that all of the above are minimum requirements; an individual's advisory committee may insist on more.The Graduate School requires each Ph.D student to complete 90 semester hours of graduate study and dissertation. The program of study must meet the following requirements:Research and Dissertation (7994*) Minimum credits 30,Courses 5000 or higher: Minimum 27 credits or 15 credits from VT with transfer courses.4000 level courses (not approved for graduate credit). Maximum 6 credits.Seminars (subject matter unstructured). Maximum 4 credits.Independent and special Study (4984, 5984, 6984). Maximum 12 credits.Or 18 total credits combined Independent and Special Study- Note: Maximum of 7994 or equivalent.EDP Graduate Courses5974: Independent Study6005-6006: Seminar in Environmental Design & Planning6104: Planning Theory Seminar6984: Special Study7994: Research and Dissertation* Courses numbered 5000 or above may not be taken on a pass/fail basis except when offered P/F only.- Any number of 4000 level courses that are approved for graduate credit may be counted toward the 90-hour total, provided that all other requirements are met.- Seminars may be taken on a pass/fail and may be used in meeting minimum requirements in courses numbered 5000 or higher. The four-hour restriction does not apply to EDP 6005 and EDP 6006.- Courses numbered 5974, 5984, and 6984 may be used in meeting minimum requirements for courses numbered 5000 and higher. Special study courses that are subsequently approved, as regular courses do not count toward the maximum permitted special study credit courses.- The transfer of credit hours from another accredited institution is done on the Plan of Study. You may transfer up to 42 hours with a B or better grade, though they may not exceed more than 50 % of the total course work.

GRADUATE COURSES (EDP)

EDP 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

EDP 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

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

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

EDP 6104:

Planning Theory Seminar

A doctoral-level seminar that traces the epistemology of major contemporary theories of planning so as to situate the activity of modern planning in an historical and intellectual context. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

EDP 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

EDP 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENVIRONMENTAL ENGINEERING

William Easterling, Head

Professors: Gregory Boardman; Andrea Dietrich; Panayiotis Diplas; Marc Edwards; Adil Godrej; Thomas Grizzard; William Knocke; John Little; Glenn Moglen; John Novak; Mark Widdowson;

Associate Professors: Randel Dymond; Daniel Gallagher; Linsey Marr; Amy Pruden-Bagchi; Peter Vikesland;

Assistant Professors: Erich Hester;

Nick Prillman Professor: John Novak;

Charles P. Lunsford Professor: Marc Edwards;

W. Curtis English Professor: William Knocke;

Emeritus Faculty: Clifford Randall;

Graduate Contact: bwingate@vt.edu

National Capital Region: jeny15@vt.edu

Extended Campus: blucas06@vt.edu

Student Handbook: http://www.cee.vt.edu/docs/File/gradpolicy.pdf

Graduate Site: http://www.cee.vt.edu/program_areas/environmental/

The Environmental Engineering Program of the Department of Civil and Environmental Engineering offers graduate study leading to the MS (thesis required) in environmental engineering and the PhD in civil engineering (with an environmental 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, and public health protection. The MS in environmental engineering is open to students from all undergraduate engineering curricula. It is specifically designed to build upon undergraduate degrees in civil, biological systems, chemical, mechanical, and mining engineering. Within a few years of program completion, graduates of the ENE program should be able to combine skills gained through academic preparation and post-graduation experience so that they can: Exhibit technical competence through application of engineering knowledge problem-solving skills, and modern tools from multiple areas of environmental engineering practice in the analysis, evaluation, design, and construction of environmental engineering systems and system components. Apply skills of effective communication, teamwork, leadership, and professional and ethical behavior as complements to technical competence. Incorporate economic, environmental, social, and sustainability considerations into the practice of environmental engineering. Continue their technical and professional development, which may include professional licensure, graduate level education, continuing education courses, self-directed study, and participation in conference and committee activities. Please refer to the Civil and Environmental Engineering listing for more detailed information on the CEE Department, the academic "home" of the ENE program.(http://www.cee.vt.edu/).

SPECIAL FACILITIES

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. Departmental faculty and students also have access to supercomputing facilities and highly specialized (CAVE) visualization capabilities through the College of Engineering.

Experimental Facilities

The environmental engineering program occupies modern laboratories in Durham, ICTAS, 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.

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.

DEGREES OFFERED

MS Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

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 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/docs/File/gradpolicy.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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

CEE 5034:

Construction Systems Design and Integration

This course will study building systems, their design and how to best manage the life cycle cost of the systems. The course will have particular emphasis on systems. The course will have particular emphasis on mechanical and electrical equipment in buildings, solar design, lighting design, site orientation, value engineering and constructability of the various systems. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5040:

Design of Construction Operations

Design and analysis of construction operations using discrete-event simulation modeling. Modeling construction operations using activity cycle diagrams. Collection and reduction of construction data. Selection of distribution models and estimation of parameters. Goodness of fit testing. Assessment of independence and autocorrelation. Design of simulation experiments. Output analysis and confidence intervals of performance measures. Variance reduction techniques.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5044:

Construction Research Presentation

This course requires that students produce a written paper and make an oral presentation based on a construction research topic of their choice. It is designed to sharpen skills in the written and oral presentation of technical material. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5050:

Construction Decisions Under Uncertainty

Construction project and organization decisions for the uncertain future. Selection of construction methods, equipment, project and operation attack strategies, contract, markup, and financing alternatives having the highest expected values and utilities. Use of decision and utility theory, competitive bid analysis, and probabilistic modeling.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5054:

Construction Performance Improvement

Skills for productivity improvement in construction, with special attention to techniques used to record and analyze operations as required to

develop and implement efficient and rewarding methods. Consideration of the human factor in generating and implementing commitments to productivity improvements. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5070:
Equipment Economics and Applications
Methodologies for determining the owning and operating cost and economic life of construction equipment. Application of engineering economics to equipment management decisions with particular reference to maintain, rebuild, replace decisions. Techniques to analyze equipment intensive operations, determine actual and delay free cycle times, match individual units and balance fleets. Synthesis of knowledge regarding production and cost to optimize productivity and reduce unit costs.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CEE 5084:
Information Technology in the Construction Industry
Information technology concepts, computer technology, analyses and design of applications as well as means and concepts to guide development, implementation, and transfer of information system applications in the Architecture/Engineering/Construction (AEC) and Engineering/Procurement/Construction Industries.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CEE 5130G:
Indoor Environ Qual Sustain
Indoor environmental quality factors and associated sustainable design methods and approaches. Air contaiminant sources, emission and dispersion patterns, health impacts, and control solutions. Methods of improving IEQ through material and ventilation solutions. Applicable regulatory requirements and sustainability organization

recommendations will be reviewed. Pre-requisite: Graduate Standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5134:

Engineering Aspects of Water Quality

The application of biological, chemical, and physical principles of water quality to engineering problems in surface waters.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

CEE 5154:

Air Pollution Control Engineering

Principles and practice of air pollution source control with emphasis on stationary source control and equipment operating and design parameters; economic and technical evaluation of control system design alternatives.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5174:

Industrial and Hazardous Wastes Control

Contemporary methods for the management and treatment of industrial wastewaters, including in-plant reductions and reuse. Characterization and management of hazardous wastes. Design of appropriate systems. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5244 (BMES 5514) (BSE 5244) (ME 5714):

Advanced GIS in Hydrologic Analysis

Advanced GIS course focusing on raster analysis with particular application to the issues associated with hydrologic analysis. Application

and evaluation of algorithms for terrain analysis, watershed characterization, and hydrologic analysis and modeling as implemented in GIS. Digital elevation data sources and error assessment. Approaches to GIS/model integration and application.
Credit Hour(s): 3
Lecture Hour(s): 2
Instruction Type(s): Lab, Lecture

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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5354:
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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5404:
Plate and Shell Structures
Classical solutions of elastic plate theory; approximate methods; continuous plates; orthotropic plates. Theory of thin shells of revolution; membrane and bending actions.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5444:
Dynamic Stability of Structures
Modern structural stability analysis; static and dynamic instability; conservative and nonconservative systems; multiple loads; and Liapunov stability analysis. Applications to columns, rotating shafts, pipes conveying fluid, and airplane panels. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5454 (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

CEE 5464 (ESM 5464) (PSCI 5484) (GIA 5484):
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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5484:

Advanced Bridge Design

Relationship of bridges to national needs; illustration of a preliminary design by case history; design of conventional bridge decks and girders; curved box-girder bridges; segmental construction; cable-stayed bridges; importance of design details on the seismic resistance of bridges.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

CEE 5494G:

Intermediate Computer Methods on Structural Design

Design of structural members in steel, concrete, and wood using computers. Computer-aided design of structural systems. Development of computer programs for the solution of structural design projects. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5630:

Design and Operation of Advanced Public Transportation Systems

An overview of the use of intelligent transportation systems (ITS), technologies and user services in design and operation of advanced public transit systems (APTS); emphasis is placed on communication, sensor application, information processing, traffic control, en-route and pre-trip information, electronic payment, and fleet management as they pertain to transit and paratransit services in large metropolitan areas as well as in small urban and rural communities.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5660:

Trans Risk, Reliab & Security

Transportation risk assessment and computation; evacuation modeling; reliability analysis; infrastructure interdependency analysis; network impact assessment. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

CEE 5670:

Applied Traffic Engr Analysis

Definition of traffic engineering and theory of traffic engineering. Evaluation and identification of traffic engineering problems and development of solutions. Application of theory to real-world problems using intersection design and control, analysis of capacity and level of service for freeways and arterials, traffic signal design and potimization, geometric design, highway and intersection simulation. Pre-requisite: Graduate Standing

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

CEE 5704:

Environmental Chemistry Laboratory

Laboratory course in support of 5104, Environmental Chemistry, allowing students to perform experiments related to natural environmental processes, including biological oxygen consumption, complexation, and carbonate equilibria. Consideration of laboratory procedures used to investigate and assess environmentally related materials and their contaminants.

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab

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

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

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

CEE 5894:

Final Examination

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

CEE 5904:

Project and Report

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

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

CEE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

CEE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

CEE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

CEE 6014:

Project and Company Management

Study of the management of a construction project and a construction company. Project management includes finances, cash flows, cost control, project organization, and project planning. Company management includes company organization incorporation structure, procedures, finance, insurances, accounting, and operation. Case studies are emphasized. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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. II

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

CEE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

CEE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ENVIRONMENTAL SCIENCES AND ENGINEERING

William Easterling, Head

Professors: Gregory Boardman; Andrea Dietrich; Panayiotis Diplas; Marc Edwards; Adil Godrej; Thomas Grizzard; William Knocke; John Little; Glenn Moglen; John Novak; Mark Widdowson;

Associate Professors: Randel Dymond; Daniel Gallagher; Linsey Marr; Amy Pruden-Bagchi; Peter Vikesland;

Assistant Professors: Erich Hester;

Charles P. Lunsford Professor: Marc Edwards;

W. Curtis English Professor: William Knocke;

Nick Prillaman Professor: John Novak;

Emeritus Faculty: Clifford Randall;

Graduate Contact: bwingate@vt.edu

National Capital Region: jeny15@vt.edu

Extended Campus: blucas06@vt.edu

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

Graduate Policy: http://www.cee.vt.edu/docs/File/gradpolicy.pdf

The Environmental Science and Engineering 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 administratiely 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

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. Departmental faculty and students also have access to supercomputing facilities and highly specialized (CAVE) visualization capabilities through the College of Engineering.

Experimental Facilities

Experimental Facilities The environmental science and engineering program occupies modern laboratories in Durham, ICTAS, 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.

Occoquan Watershed Monitoring Laboratory (Manassas, Virginia)

The environmental science and engineering program also includes the Occoquan Monitoring Laboratory (Manassas, Virginia), where research focuses on wastewater resuse, reservoir eutrophication control, and watershed monitoring and management.

DEGREES OFFERED

MS Degree

Offered In (Virtual, National Capital Region, Blacksburg)

TOEFL

Paper: (570.0)

Computer: (230.0)

iBT: (88.0)

GRE

General Test: Verbal, Quantitative, Analytical

MS ESEN degree may be taken either as coursework only or with the permission of the faculty may incorporate a research thesis. See Departmental Manual: http://www.cee.vt.edu/docs/File/gradpolicy.pdf

FINANCE

Vijay Singal, Head

Professors: Janine Hiller; Gregory Kadlec; Raman Kumar; Sattar Mansi; George

Morgan; Douglas Patterson; John Pinkerton; Meir Schneller; Dilip Shome; Vijay Singal; G Thompson;

Associate Professors: Randall Billingsley; John Easterwood; Abon Mozumdar;

Assistant Professors: Yong Chen; Michael Cliff; Ozgur Ince;

R. B. Pamplin Professor of Finance: Gregory Kadlec;

R.V & A.F Oliver Professor of Investment Management: Raman Kumar;

SunTrust Professor of Finance: George Morgan;

SunTrust Professor of Banking: John Pinkerton;

J. Gray Ferguson Professor of Finance: Vijay Singal;

Graduate Contact: finterryg@gmail.com

Ph.D. Program: mcliff@vt.edu

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

The Department of Finance, Insurance and Business Law offers graduate studies leading to three advanced degrees: the Ph.D., M.B.A., and M.S. in business (with specialization in finance). MBA degree is managed by Pamplin college, not individual departments. The Ph.D. degree requires dissertation on an approved research topic in finance. The objective of the doctoral program in finance is to prepare the student for a career in academe or at the research level of private and public organization and to publish in top scholarly journals. This is a research-oriented degree wherein the student must display a deep understanding of both financial theory and practice through the completion of an original piece of research (the dissertation). Strong methodological training is necessary to successfully complete the program. The M.B.A. is a non-thesis degree program that allows for specialization in finance through the selection of appropriate course electives. In addition, M.B.A. students may pursue concentrations in investment and financial services management, and corporate financial management. More details about the M.B.A. program are available at http://www.mba.pamplin.vt.edu. 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.

SPECIAL FACILITIES

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

PhD program requires a Bachelors Degree

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

PhD program requires a Bachelors Degree

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

FIN 5034:

Internet Law and Policy

Intensive examination of public and private regulation of the Internet at the local, national, and international levels. The broad areas covered are Internet as a communication medium; privacy, security and trust; intellectual property; and electronic commerce. Specific topics include freedom of speech, encryption, and distance education. The course will examine private means of regulation, national, and state policies and international perspectives of Internet law. Pre: Graduate standing or consent of instructor. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FIN 5044:

Asset Valuation

Focuses on techniques for the valuation of non-financial assets such as projects, business units, private and public firms. Specific topics include method of comparables, discounted cash flow methods and the real options approach to valuation.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

FIN 5054:

Options and Futures

This course provides an introduction to Derivative Securities like Options, Futures, and Forwards. The specific topics covered will include the payoffs and profits of Puts, Calls, and Forward contracts, one period binomial option pricing model, the use of Black-Scholes option pricing model, the relationship between the Spot and Forward prices, and an introduction to Real Options.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

FIN 5064:

Equity Markets

Examines the role and functioning of the equity markets. Specific topics include the market structure and securities trading, overview of investment companies, and equity valuation models with brief overview of statistical properties of equity returns.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

FIN 5094:

Financial Databases and SAS

The course provides and introduction to databases that are used for research in Finance and Accounting, and the use of SAS for data analysis. The course is designed for Ph.D., students in business. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

FIN 5134:

Investment Banking in A Global Environment

Examines advanced topics confronting investment banks as intermediaries in the raising capital and corporate restructuring processes. The topics include the U.S. and international structure and regulation of investment banking, global market strategies, intermediation theories, corporate going public and raising capital in a global market, corporate restructuring transactions, investment banking innovations, municipal financing, and ethics. The course contains a strong analytical component and also uses case studies.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FIN 5164:

Advanced Corporate Finance

Covers advanced topics in the basic policy making areas of corporations and special topics in corporate finance. The advanced topics are presented in the framework of the more current theories of corporate finance. The course also has a strong applied component in the form of case studies and computer applications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

FIN 5204:

Managing Corporate Capital Investment and Capital Structure

Explores value creation through capital investment and capital structure choices. The capital investment and capital structure policies of a corporation have a very significant impact on its value and this course explores how these policies are established in the framework of modern finance theory. The course has a theoretical component and an applied component in which the case method is used.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

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

FIN 5224:

Portfolio Management

This course focuses on portfolio management and asset pricing. Specific topics include portfolio theory, asset pricing models (Capital Asset Pricing Model, Arbitrage Pricing Theory, among others), market efficiency and performance evaluation.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

FIN 5234:

Venture Capital and Investment Banking

Explores the venture capital cycle of fund-raising, investing in portfolio firms, and exiting the investment. Focuses on the role of investment banking in the exiting of investments by taking the portfolio firms public through initial public offerings. Comprises a conceptual component and an applied component in which the case method is used.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

FIN 5244:

Managing Corporate Risk with Derivatives

Identification of domestic and global risk management problems of corporations. Application of derivative contracts to the solution of corporate risk management problems. Use of real world examples and cases of risk management.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

FIN 5254:

Financial Institution Risks and Strategies

Emphasis on the major issues facing managers and owners of financial institutions, primarily commercial banks. Topics include the risks and rewards associated with granting credit, managing liquidity, interest rates/currency positions, technology, and sovereign borrowers. The role of capital adequacy and the interaction of other regulatory aspects of the environment with managerial strategies and owner interests are emphasized throughout the course. Students run a simulated bank for the full semester.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

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

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

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

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

FIN 5624:

Valuation and Corporate Restructuring

Explores value creation through corporate restructuring. Provides detailed coverage of alternative valuation methods and explores the major asset and liability restructurings undertaken by a firm. The specific topics covered are valuation techniques, mergers and acquisitions, spin-offs, divestitures/asset sales, leveraged recaps, and leveraged buyouts. Executive MBA students only.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

FIN 5634:

Legal and Ethical Issues in the High Technology Environment

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 the networked environment. Explores the interrelationship of ethics and law, the duties of directors and managers, and decision-making under uncertain regulatory parameters. Included within these areas are; participating in the regulatory process, intellectual property, ethical frameworks, Internet privacy and security, and international perspectives. Executive MBA students only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

FIN 5644:

Issues in Corporate Governance

Current issues and trends in corporate governance. Topics include overview of the corporation, stakeholder versus shareholder, board of directors, regulatory and legal environment, and executive compensation. Graduate standing in Executive MBA program required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

FIN 5684:

International Finance

International economic environment, currency regimes, and currency crises; analysis of foreign exchange rates. Firms' exposure to exchange risk and methods for managing risk. Executive MBA students only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

FIN 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FIN 5954:

Study Abroad

Credit Hour(s): 1 TO 6

Lecture Hour(s): 1 TO 6

Instruction Type(s): Lecture

FIN 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

FIN 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

FIN 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

FIN 6144:

Advanced Topics in Finance

Advanced topics of contemporary interest in finance. The course can be focused on a single area such as financial derivatives and risk management, mergers and acquisitions, investment banking, global financial markets, or financial regulation, or can reflect a combination of topics from several areas. Pre: Three credits in 6000 level FIN courses and consent of instructor.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FIN 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

FIN 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

FISHERIES AND WILDLIFE SCIENCES

Eric Hallerman, Head

Professors: Paul Angermeier; James Fraser; Eric Hallerman; Brian Murphy; Donald Orth; Dean Stauffer;

Associate Professors: James Berkson; C Dolloff; Carola Haas; William Hopkins; Marcella Kelly; Steve McMullin; James Parkhurst;

Assistant Professors: Kathleen Alexander; Emmanuel Frimpong; Yan Jiao; Sarah Karpanty;

Emeritus Faculty: Richard Neves; Michael Vaughan;

Graduate Contact: smcmulli@vt.edu

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

The Department of Fisheries and Wildlife Sciences 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 and food fish 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.

College of Natural Resources & Environment Human Dimensions Lab

The Human Dimensions Lab is used by faculty and students throughout the College to conduct research related to the human dimensions of natural resources conservation. The lab has space for two graduate student offices, as well as two computer work stations for general use. The computers at the general use stations are set up to conduct on-line surveys and have special software installed for design and implementation of surveys.

Mussel Research and Propagation Laboratory

This research facility is used to conduct research on threatened and endangered species of freshwater mussels and to propagate mussels for reintroduction into aquatic environments.

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 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 GRE scores at or above 550 in verbal and 600 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.

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 GRE scores at or above 550 in verbal and 600 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

FIW 5014 (NR 5014) (FOR 5014):

Constructing Sustainability

Synthesize ecological, economic, and social dimensions of sustainable and resilient systems. Examine history, theory, current status, and future prospects of sustainablity 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

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

FIW 5174G:

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

FIW 5214:

Vertebrate Population and Habitat Analysis

Application of quantitative methods to data collected on wild vertebrates. Philosophy and principles of study design and hypothesis testing. Habitat sampling design and analysis for terrestrial and aquatic systems. Population estimation including indices, distance measures, open and closed-population mark-recapture estimators. Current approaches to estimating survival and reproductive parameters. Integrating population and habitat data to assess resource preference. Principles of habitat modeling and community measures. Even Years. Pre: an introductory graduate level statistics class. I.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

FIW 5224:

Wildlife Population Dynamics

Advanced course in wild animal population dynamics with emphasis on research concerning theories of population regulation. Discussion topics include characteristics of population growth, age and sex composition in relation to population growth, general features of population fluctuations, and natural control and regulation of bird and mammal populations. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

FIW 5334:

Vertebrate Physiological Ecology

Physiological and behavioral adaptations of vertebrates inhabiting extreme environments. Artic, desert, cave, high altitude, deep sea, tidal pools, estuarine. Pre: Introductory course in physiology (FiW 2314, Biol 3404 or equivalent). Graduate standing required. Even years. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

FIW 5454G:

Advanced Vertebrate Pest Management

Management of vertebrate pest species; causes and prevention of damage by vertebrate pest species to food and fiber plants, animal production, structures, human transportation systems, and health of human and domestic animals. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

FIW 5734:

Fisheries and Wildlife Planning

Use of logic, software packages, and programming skills necessary to effectively create and apply computer programming languages as needed in the discipline of Fisheries and Wildlife Sciences. Instruction in two programming manguages, one to learn beginning programming skills and a second to learn more advanced features such as comples, built-in functions. Construction and use of a graphical user interface. Application of computer programming to problems in Fisheries and Wildlife Sciences. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FIW 5744:

Sim Modeling Fish & Wildlife

Application of simulation models to problems in Fisheries and Wildlife Sciences. Modeling in the context of cybernetics. Model theory, terminology, creation, exploration, and testing. Present models to technical and non-technical audiences. Critically examining classic and current modeling literature in fisheries and wildlife sciences. Population dynamics models including harvest, stock assessment, and population of viability.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

FIW 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FIW 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

FIW 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

FIW 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

FIW 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

FIW 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

FIW 6214:

Advanced Habitat Analysis

Conceptual and applied aspects of analysis of wildlife- habitat relationships. Modeling population response as a function of habitat characteristics. Model selection and evaluation using R2, Akaike's Information Criterion, Bayesian Information Criterion, and concordance. Use-availability analysis with resource-selection functions. Analyzing habitat patterns with multivariate approaches including Principal Components Analysis, Discriminant Function Analysis, and Cluster Analysis. Understanding of SAS required. Even years. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

FIW 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

FIW 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

FOOD SCIENCE AND TECHNOLOGY

Joseph Marcy, Head

Professors: Susan Duncan; George Flick; Michael Jahncke; Joseph Marcy; Sean O'Keefe; Susan Sumner; Bruce Zoecklein;

Associate Professors: Joseph Eifert; William Eigel; Robert Williams;

Assistant Professors: Renee Boyer; Monica Ponder;

Emeritus Faculty: Paul Graham; Norman Marriott; Merle Pierson;

General Contact: fstinfo@vt.edu

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

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). In fact, the highest food safety position in the US government has been held by a Virginia Tech Food Science and Technology graduate!

SPECIAL FACILITIES

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

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

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.

MSLFS Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

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

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

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

FST 5024:

Food Regulatory Affairs

History, development and enforcement 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, international trade, and processor employees. Roles and responsibilities of consumers and industry in the development of and compliance with food laws and regulations. Two of the four prerequisites listed are required. Odd years.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

FST 5084 (BMVS 5084) (CHEM 5084):
Macromolecular Interfaces with Life Sciences Seminar
Experience in developing and presenting a technical seminar related to oxidative processes at the macromolecule- biomolecule interface. Tours and presentations at research facilities at regional industrial sites. Idea generation for the purpose of resolving technical questions and advancing research projects. 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): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

FST 5094 (PSCI 5564) (GIA 5564) (CHEM 5094) (WS 5564) (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. (3H, 3C). Graduate standing required. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

FST 5114:
Introduction to Risk Management for Health Products
Overview of historical development in perspectives of risks and a survey of risk management models used by federal agencies such as the Food and Drug Administration and U. S. Department of Agriculture. Introduces commonly used terminology and its applications in a wide variety of risk management scenarios. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

FST 5124:
Risk Management as a Business Strategy for Health Product Industries
Introduces an enterprise risk management framework as a business strategy to stimulate innovation in uncertain environments, to minimize product liability issues, and formulate strategies to address insurance coverage. Establishes a comprehensive product liability program and institutes safeguards to avoid future legal actions and losses. Incorporates theories of risk management and human behavior, related to product stewardship, in product design. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

FST 5134:
Risk Science in Pharmaceutical Processes - Tools and Techniques
Management of health care pharmaceutical product and process risks. Risk management model using International Committee on Harmonization guidelines for clinical trials, pharmacovigilance, and quality risk management. Principles of Functional Analysis, Fault Tree Analysis, Failure Mode and Effects Criticality Analysis, Hazard Analysis and Critical Control Points, Hazard and Operability Study. Application of these tools on currently marketed pharmaceutical products and processes.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

FST 5144:
Risk Science in Medical Device Processes - Tools and Techniques
Overview of the historical development of the total life cycle risk management framework for risk management of medical devices. Detailed analysis of International Organization for Standardization (ISO) 14971 as the world-wide risk management framework for managing medical device products and processes. Integration of related regulatory requirements and other standards requirements affecting medical devices. Associated tools including fuctional analysis, fault tree analysis, failure mode and effects analysis, hazard analysis and critical control points, hazard and operability study.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

FST 5154:

Risk Mgmt New Health Prod

Risk management models for managing challenges related to new and emerging developments in health product devices and pharmaceutical products such as biotechnology, nanotechnology, and wireless technology. Compliance/ regulatory issues and product development/manufacturing risks applied to emerging technologies. Application of risk management tools, techniques, and approaches to address recent, innovative products or hypothetical products. Emphasizes development of novel approaches to new technologically advanced health products.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

FST 5164:

Health Product Risk Communication & Incident Handling

Survey of different international regulations and incident reporting systems including those of North America, Europe and Asia. Case studies of solutions to post-market problems as related to risk management. Discussion of a "culture" of risk communication for a hypothetical company. How to provide risk-based solutions to senior management.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

FST 5184:

Economic Analysis of Health Product Risk

Examines application of economic analytical tools based on risk management principles to healthcare products and the effect on corporate profitability. Surveys approaches suitable for economic analysis of healthcare product risk as applied throughout product life-cycle. Analyze profit vs. cost, risk vs. benefit, loss to the company, and loss to society as a result of adverse outcomes of healthcare product risks. Examines how risk management generates short and long term financial benefits for healthcare product manufacturers. Creates applicable models to analyze current issues based on available public information.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

FST 5384 (HNFE 5724) (CHEM 5384) (BMVS 5384) (PHS 5024):

Oxidation at the Interface of Chemistry and Biology

An advanced survey of the chemistry and biochemistry associated with oxidation reactions and the relationship to positive and detrimental outcomes in synthetic and natural macromolecules and biological systems. Topics include free radical chemistry, reactive oxygen and nitrogen species in living systems, enzyme-catalyzed oxidations, oxidation of foods and materials, oxidative stress and health effects, chemistry of antioxidants. 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

FST 5884:

Macromolecular Chemistry at the Biology Interface Laboratory

An advanced laboratory course that involves state-of-the-art experimental techniques with applications for data interpretation and presentation for future professionals at the polymer chemistry-biology interface. Team-oriented experiments will use traditional and emerging polymer chemistry techniques and applied biological methods, specifically those involving analysis of free radical and oxidative processes. PRE: CHEM/FST/BMVS 5384 or simultaneous enrollment in this course.

Credit Hour(s): 0 OR 2

Lecture Hour(s): 0 OR 1

Instruction Type(s): Lab, Lecture

FST 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

FST 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

FST 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

FST 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

FST 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

FOREIGN LANGUAGES, CULTURES, AND LITERATURES

Richard Shryock, Head

Professors: Jacqueline Bixler; Judith Shrum; Justo Ulloa;

Associate Professors: Jessica Folkart; Medoune Gueye; Sharon Johnson; Moses Panford; Richard Shryock; Fabrice Teulon; Ronda Watson;

Assistant Professors: Elisabeth Austin; Aarnes Gudmestad; Corinne Noirot; Sarah Sierra;

Graduate Contact: MA.FLCL@vt.edu

Graduate Site: http://www.fll.vt.edu/MA/

The Master of Arts in Foreign Languages, Cultures & Literatures 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. The program serves the interests of students seeking an interdisciplinary approach to learning. Coursework includes areas such as literature, cultural studies, cinema, art history, translation, linguistics and business.The core of the program provides a solid foundation in Hispanic, French, and Francophone cultures and literatures. It stresses the acquisition and development of analytical abilities based on a range of critical approaches. These skills prepare students to work independently in a variety of settings. The students may be beginning or experienced teachers of secondary-level Spanish and French, those planning to work in international environments, or those considering doctoral studies at other universities.

SPECIAL FACILITIES

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General: Verbal, Quantitative, Analytical

The program offers three tracks: French and Francophone Studies, Hispanic Studies, and Multilingual Studies. Within each track, students will take a combination of required core courses and electives. In addition to coursework, students must either write a thesis or take an examination based on a reading list. A committee of three faculty members will evaluate the thesis or the examination results. Procedures and requirements are outlined in the program's Policies and Procedures manual. It is expected that students enrolled full time will complete all degree requirements within two academic years. This normally includes devoting the summer to do research for the thesis or to prepare for the examination. For further details, see the program's policy manual, available at www.fll.vt.edu/ma.

FORESTRY

Janaki Alavalapati, Head

Professors: Janaki Alavalapati; Gregory Amacher; Wallace Aust; Harold Burkhart; Thomas Fox; Robert Hull; Stephen Schoenholtz; John Seiler; Bradley Sullivan; Randolph Wynne; Shepard Zedaker;

Associate Professors: Amy Brunner; Carolyn Copenheaver; John McGee; Stephen Prisley; Philip Radtke;

Assistant Professors: Michael Bolding; Gwenlyn Busby; Susan Day; Jason Holliday; John Munsell; Marc Stern; Brian Strahm; Valerie Thomas; Phillip Wiseman;

Research Faculty: Kevin McGuire;

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

Offered In (Blacksburg)

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. For students entering the M.F. program without prior forestry education, a minimum of 18 credit hours in forestry core courses must be completed in addition to the usual M.F. requirements. The 18 core credit hours must consist of Forest Biology and Dendrology (FOR 2314, 2 credits), Dendrology Lab (FOR 2324, 1 credit), Survey of Forest Ecology and Management (FOR 3364, 3 credits), plus a total of 12 credit hours in forestry courses--of which 9 credit hours must be at a 3000 level or higher. 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

Offered In (Blacksburg)

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 major field of 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 (FOR)

FOR 5004:

Graduate Seminar

Special topics, critical reviews, and discussions of pertinent literature throughout a wide range of subject areas in forestry. May be repeated. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

FOR 5014 (NR 5014) (FIW 5014):

Constructing Sustainability

Synthesize ecological, economic, and social dimensions of sustainable and resilient systems. Examine history, theory, current status, and future prospects of sustainablity 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

FOR 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

FOR 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

FOR 5124:

Law of Natural Resource Management

Seminar-styled graduate course will explore the legal principles underlying the management of the various natural resources of the United States. Emphasis will be placed on understanding the evolution of the current state of the law, as well as on the resultant management implications on both private and public lands. Topics covered will include: public lands, wildlife, preservation and recreation, range, minerals, timber, water, and a discussion of the legal aspecst of ecoterrorism. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FOR 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

FOR 5154 (GEOG 5154) (GEOG 5024) (HIST 5024) (FL 5024):

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

FOR 5214:

Advanced Forest Inventory

An advanced course in forest inventory and sampling. Topics include the foundations of point, plot, and probability proportional to prediction sampling, application of Bayesian and James-Stein methods, and unequal probability sampling in the forest setting. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FOR 5224:

Forest Biometry

Theory and practice involved in the measurement and modeling of the growth and yield of forest trees and stands I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FOR 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. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

FOR 5264 (ASPT 5214) (HIST 5214) (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. I.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

FOR 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. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

FOR 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. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

FOR 5354G:

Advanced Forest Soils and Hydrology

Principles of forest soils and hydrology and applications of forest management. Forest soil development, relationships of soils and hydrologic properties to sustainble forest and watershed management. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

FOR 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. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

FOR 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

FOR 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

FOR 5415:

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

FOR 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

FOR 5454G:

Advanced Urban Forest Managemet and Policy

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

FOR 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

FOR 5474 (HNFE 5684) (EDHP 5604) (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

FOR 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. II
Credit Hour(s): 2
Lecture Hour(s): 2
Instruction Type(s): Lecture

FOR 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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

FOR 5714:

Environmentally Sensitive Harvesting

Timber harvesting practices and its relationship with the environment. Comparing current USA harvesting practices and regulations with other timber producing countries. Overview of best management practices; including the role of federal, state and non-governmental agencies. Forest product certification and environmental management systems; such as Sustainable Forestry Initiative, Forest Stewardship Council and International Standards Organization. Techniques for measuring impacts on the environment. Harvesting for non- timber goals, such as wildlife, aesthetics, reduction of fire risk and ecosystem management. Low impact harvesting systems; modifications of existing systems; helicopter, cable, cut-to-length and horse logging. Graduate standing required. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

FOR 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

FOR 5894:

Final Examination

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

FOR 5904:

Project and Report

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

FOR 5954:

Study Abroad

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

FOR 5974:

Independent Study

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

FOR 5984:

Special Study

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

FOR 5994:

Research and Thesis

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

FOR 6214 (GEOG 6214):

Forestry Lidar Applications

Theoretical underpinning of established and emerging research using light detection and ranging (lidar) technology for forestry applications including detailed terrain mapping and digital elevation models, canopy height modeling, prediction of forest biophysical parameters, forest physiology and the canopy light regime, watershed mapping and stream modeling, ecological modeling, 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

FOR 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

FOR 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

GENETICS, BIOINFORMATICS, AND COMPUTATIONAL BIOLOGY

David Bevan, Head

Professors: Christopher Barrett; Edward Fox; Elizabeth Grabau; Ruth Grene; Lenwood Heath; Khidir Hilu; Ina Hoeschele; Reinhard Laubenbacher; David Notter; Andy Pereira; Narendran Ramakrishnan; Mohammad Saghai-Maroof; Clifford Shaffer; Edward Smith; Bruno Sobral; James Turner; Brett Tyler; John Tyson; Richard Veilleux; Layne Watson; Doris Zallen;

Associate Professors: Josep Bassaganya-Riera; David Bevan; Glenda Gillaspy; Robert Grange; Richard Helm; John Jelesko; Christopher Lawrence; Ronald Lewis; Christopher North; Jean Peccoud; Pedro Pedrosa Mendes; Adrian Sandu; Eunice Santos; Joao Setubal; Vladimir Shulaev;

Assistant Professors: Zachary Adelman; Yang Cao; Vicky Choi; Allan Dickerman; Erin Dolan; Maria Lazar; Biswarup Mukhopadhyay; T Murali; Kevin Myles; Alexey Onufriev; Florian Schubot; Igor Sharakhov; Boris Vinatzer; Jianhua Xing; Liqing Zhang;

Affiliated Faculty: Oswald Crasta; Stephen Eubank; Madhav Marathe; Henning Mortveit; Anil Vullikanti;

Graduate Contact: dennie@vbi.vt.edu

GBCB Home Page: http://www.grads.vt.edu/academics/programs/gbcb/

The new research paradigm exemplified by the Human Genome Project requires a new academic training paradigm, one 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, bioinformatics, and computational biology. This program will allow PhD 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

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

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

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

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

GBCB 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

GBCB 5844:

Plant Genomics

Comprehensive overview of genomics and its applications. Topics include: molecular markers, map construction, map-based cloning, quantitative trait loci, and functional genomics. Even years. Pre: Knowledge of general principles of genetics and molecular biology. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GBCB 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

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

GBCB 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

GBCB 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 9

Instruction Type(s): Lecture

GBCB 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

GEOGRAPHY

Laurence Carstensen, Head

Professors: James Campbell; Laurence Carstensen;

Associate Professors: Lisa Kennedy; Lynn Resler;

Assistant Professors: Korine Kolivras; Robert Oliver;

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: 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 new 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 a full range of XP workstation for classes and for research, including specialized systems for GIS, cartography, and remote sensing. Software packages include the complete suite of desktop and workstation ArcGIS, ArcEngine, Surfer, Visual Studio (for application development), Trimble GPS Pathfinder, IDRISI Andes, 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 (500.0), Quantitative (500.0), Analytical

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 (550.0), Quantitative (550.0), Analytical

The Geospatial and Environmental Analysis PhD. degree is housed in the College of Natural Resources and 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 an environmentally oriented project.

GRADUATE COURSES (GEOG)

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GEOG 5024 (FOR 5154) (HIST 5024) (FL 5024):

Area Studies Methods

Introduction to recent theories and methods in history, foreign languages and literary studies, and geography with a focus on issues that have facilitated exchanges between the three disciplines. Practical aspects of Area Studies research are highlighted with particular reference to Latin America, the Caribbean, and Europe. The formulation of research problems using interdisciplinary approaches is given special attention. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

GEOG 5084G:

Intermediate Geographic Information Systems

Use of automated systems for geographic data collection, diditization, 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

GEOG 5104 (FOR 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

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

GEOG 5154 (FOR 5154) (HIST 5024) (FL 5024):
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

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

GEOG 5224:
Tourism and Sustainability
Examines the role of natural and cultural sustainability in international tourism. Theoretical perspectives on conceptualizing and operationalizing sustainable tourism. Case studies drawn mainly from low-income and tropical climes. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

GEOG 5234:
Human Impacts on the Environment
Human impacts on patterns and processes in the physical environment, including hydrology, soil and landforms, climate and atmosphere, and biota. Social and cultural processes associated with human impacts. Analysis of causes of geographic variations in impacts on environment, including differences between developed and developing countries, arid and humid environments, and islands and continents. Historical and contemporary transformations in the environment considered.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

GEOG 5244:
Advanced Soil Interpretation Using GIS and DSS
Use of Geographic Information System (GIS) software to complie digital maps, imagery, and natural resource data and decision support systems (DSS) to produce interpretative maps from digital soil data as part of a research proposal and project. Field trip and class attendance required.
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

GEOG 5264:
Global Change and Local Impacts
All jurisdictions, national, regional, or local, function in an interconnected global market. Understanding the structure and interactions within that global market and the impacts therein is the focus of UAP 5264. Thematic topics include a review of welfare state functions, privatization,

decentralization, and nonprofit organizations and their relation to global market dynamics. Upon completion of the course, students will have an understanding of how global forces influence local areas and how local leaders have developed strategies to cope with their position in an increasingly global market. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

GEOG 5344:

The Globalization of Nature

The transport of species including plants, animals, and microbes, around the world by people in both historical and recent times. The causes, consequences, and global patterns of biological invasions. The impacts of invasive species on physical and biotic systems, including the human condition, will be a major theme, along with discussion of current high-tech mitigation strategies. Societal attitudes toward "exotic" and "invasive" species will also be considered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GEOG 5354:

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.

Pre-Requisite: Graduate Standing Required

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

GEOG 5364 (ASPT 5214) (FOR 5264) (HIST 5214):

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. I.

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

GEOG 5384:

Prog for Geo Info Sys

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GEOG 5434:

Topics in Regional Geography

Selected topics concerning development and change in a specific region such as Sub-Saharan Africa, the Caribbean, Appalachia, or the European Community. Spatial, ecological and historical perspectives, including examination of pertinent social theory. Can be taken up to three times provided the subject material is different.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

GEOG 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GEOG 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

GEOG 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

GEOG 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

GEOG 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

GEOG 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

GEOG 6214 (FOR 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

GEOG 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

GEOG 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

GEOSCIENCES

Kenneth Eriksson, Chair
James Spotila, Associate Chair

Emeriti Faculty: John Costain; Gerald Gibbs; James Read; James Rimstidt; Akhaury Sinha; J Snoke;

Professors: Robert Bodnar; Patricia Dove; Kenneth Eriksson; Michael Hochella; Scott King; Michal Kowalewski; Richard Law; Nancy Ross; Robert Tracy; Shuhai Xiao;

Associate Professors: Thomas Burbey; John Hole; Madeline Schreiber; James Spotila; Chester Weiss;

Assistant Professors: Barbara Bekken; Ying Zhou;

Research Faculty: Ross Angel; Martin Chapman; Robert Lowell;

Adjunct Professors: James Beard; John Chermak; Benedetto De Vivo; Alton Dooley; Nicholas Fraser; William Henika; Jerry Hunter; Neil Johnson; Csaba Szabo; Lauck Ward; Chester Watts;

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

C.P. "Sally" Miles Professor of Science: Patricia Dove;

Graduate Contact: clowe@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. 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/.

SPECIAL FACILITIES

The Department of Geosciences is currently housed in Derring Hall. Our Derring laboratory and research space includes (see http://www.geos.vt.edu/research/facilities.php for more details):The John K. Costain Geophysics Computing FacilityAqueous Geochemistry LaboratoryBiogeochemistry of Earth Processes (BGEP) Laboratory Chemical Hydrogeology Lab Electron Beam LaboratoryExploration Geophysics Field Equipment LaboratoryFluids Research LaboratoryGeothermal DatabasePhysical Hydrogeology LaboratoryHydrothermal LaboratoriesMicropaleontology LaboratoryNanogeochemistry, Mineral Surface Geochemistry, and Biogeochemistry LaboratoryPaleobiology LaboratoryPaleoecology LaboratoryRadiogenic Helium LaboratorySedimentology and Stratigraphy LaboratorySeismological ObservatoryStructure Laboratory Vibrational Spectroscopy LaboratoryIn addition to Derring Hall, the Department of Geosciences has laboratory space in several other facilities, including:Crystallography Laboratory in the Integrated Life Sciences Building (http://www.crystal.vt.edu/crystal/index.html)Nanoscale Characterization and Fabrication Laboratory in the Institute for Critical Technology and Applied Sciences (http://www.ictas.vt.edu/facilities/ncfl.shtml)

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)

GRE

General Test: Verbal (550.0), Quantitative (650.0), Analytical (4.5)

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.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (80.0)

GRE

General Test: Verbal (550.0), Quantitative (650.0), Analytical (4.5)

Ph.D. students must pass a minimum of 90 credit hours, at least 30 of which must be taken as coursework, and at least 6 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.

GRADUATE COURSES (GEOS)

GEOS 5004:

Analytical Geosciences

Analytical techniques used in modern geosciences, including practical training in acquisition and processing of geological, geophysical, geochemical, and geobiological data. Topics include strategies of data acquisition and processing applied in geosciences, shape and size analysis of physical objects (fossils, clasts, etc.) and digital images (maps, thin sections, etc.), evaluation of time or space series, stastical analyses and parameter estimation and inversion of geoscientific data, and data-constrained numerical modeling of geological patterns and processes. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

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

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

GEOS 5114:

Theoretical Seismology

Vibrations and waves, principle of the seismograph, elastic waves in unbounded media, and body and surace waves in a half-space and a layered half-space. Seismic ray theory for spherical media. Consent required. Alternate years. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

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): 0 OR 3

Lecture Hour(s): 0 TO 2

Instruction Type(s): Lab, Lecture

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

GEOS 5374:

Quantitative Paleobiology

Use of quantitative methods in paleontology. Analysis of paleontological data. Modelling the macroevolutionary process. The role of quantification in establishing a rigorous science of paleontology. Consent required. Alternate years. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GEOS 5384:

Morphometrics

Study of shape and size in fossil and modern organisms with strong focus on quantitative methods and digital image analysis. Covers analytical methods (multivariate methods, Fourier analysis, geometric morphometrics), image processing, and software training (SAS, SAS/IML, and Imaging Software).

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

GEOS 5525:

Electron Microprobe

Theory and practice of qualitative and quantitative elemental microanalysis using electron-excited x-rays. Consent required. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

GEOS 5526:

Electron Microprobe

Theory and practice of qualitative and quantitative elemental microanalysis using electron-excited x-rays. Consent required. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

GEOS 5536 (CHEM 5526):

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

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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

GEOS 5814:
Numerical Modeling of Groundwater
Theory and practice of numerical techniques are developed and applied to fluid flow and transport in ground-water flow systems. Governing equations are formulated using FD and FE techniques with appropriate 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

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

GEOS 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

GEOS 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

GEOS 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

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

GEOS 6194:
Seminar in Geophysics
Critical review of recent published works on selected topics in geophysics. Consent of instructor required. Alternate years. May be repeated for a maximum of 8 credits.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

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

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

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

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

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

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

GEOS 6804:

Advanced Topics in Hydrogeology

Advanced analysis of one or more topics of hydrogeology. Can be taken up to three times provided the subject material is different. Pre: Consent of instructor.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

GEOS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

GEOSPATIAL AND ENVIRONMENTAL ANALYSIS

General Contact: geospatial@vt.edu

Graduate Site: http://www.cnr.vt.edu/gea/gea.htm

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).

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.

GOVERNMENT AND INTERNATIONAL AFFAIRS

Timothy Luke, Head

Professors: Gerard Kearns; Ilja Luciak; Timothy Luke; Joyce Rothschild; Gerard Toal; Edward Weisband;

Associate Professors: Wilma Dunaway; Joel Peters; Karen Till;

Assistant Professors: Giselle Datz; Rupa Thadhani;

Affiliated Faculty: James Bohland; Matthew Dull; Heike Mayer; Randall Murch; David Orden; Georgeta Pourchot; Ioannis Stivachtis; Kris Wernstedt; James Wolf;

University Distinguished Professor: Timothy Luke;

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

Blacksburg: karenn@vt.edu

Graduate Program Director: twluke@vt.edu

National Capital Region: mlechuga@vt.edu

Graduate Program Director NCR: toalg@vt.edu

Blacksburg: http://www.gia.vt.edu/blacksburg/

National Capital Region: http://www.mpia.vt.edu/index.php?page=home

Student Handbook: http://www.gia.vt.edu/blacksburg/index.php?q=node%2F14

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 masters degree, or the Masters in Public and International Affairs (MPIA), and the Governance & Globalization (G&G) Stream in the Planning, Governance & Globalization Ph.D. program, which is a college-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 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

DEGREES OFFERED

PhD Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

MAXIMUM AND MINIMUM REQUIREMENTS FOR MASTERS DEGREE Project & Report Option5000 level courses (min.*) 33 credit hours**5904 Project & Report (max.) 3 credit hours Thesis Option5000 level courses (min.*) 30 credit hours**5994 Research & Thesis (max.) 6 credit hoursTotal Hours for either Project & Report or Research & Thesis Option: 36*does not include 5904, 5994**5974, & 5984 (max.) 6 credit hours allowedFor more information, see:MPIA HandbookBlacksburg Students have a Thesis or Major Paper as options. National Capital Region students currently have a Major Paper option.

MPIA Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

MAXIMUM AND MINIMUM REQUIREMENTS FOR MASTERS DEGREE Guidelines for Graduate Courses Hours4000-level courses (max. grad credit) 65000-level courses (min.*) 215974, & 5984 (max.) 95804Practicum (max.) 25904Project & Report (max.) 35994Research & Thesis (max.) 6Total Hours 36*does not include 5804, 5904, 5994http://www.gia.vt.edu/blacksburg/q=node/10Blacksburg Students have a Thesis or Major Paper as options. National Capital Region students currently have a Major Paper or Practicum as options not a Thesis.

GRADUATE COURSES (GIA)

GIA 5004 (UAP 5004):

Power and Policy in the U.S.

Social science theory and research on the distribution of power in the US, especially as it shapes important national policy outcomes. Institutional and class bases of power will be examined, including membership on corporate boards and in policy-shaping think tanks. Implications for democracy in society will be drawn. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GIA 5034 (STS 5206) (HIST 5206) (UAP 5034) (PAPA 5034):

Democratic Governance in the Economy

An international and comparative examination of workplace and economic relations around the world, with special focus on efforts to build collaborative work processes that would extend the voice, ownership and control rights of workers. The interface between state institutions and economic organizations is also considered, especially insofar as government prescriptions and processes that may impede or extend democratic governance of the economy. Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

GIA 5104 (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

GIA 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

GIA 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

GIA 5164 (PSCI 5164) (UAP 5164):

Collaborative Gov

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

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

GIA 5224 (PSCI 5224):

Perspectives Pol Theo

Analysis of selected perspectives on politics including rational choice theory, critical theory, neo-marxism, neo-conservatism, post-industrialism, and post-structuralism.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

GIA 5254 (PSCI 5254) (UAP 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

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

GIA 5284 (UAP 5274) (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

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

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

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

GIA 5384:

Global Economic Diplomacy

Examines dynamics of international trade, institutional structures, and treaty-based rules under which trade takes place. Econmic theory of trade, multilateral governance structure of the World Trade Organization; political economy of trade negotiation; and the legal system of multilatral dispute settlement. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

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

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

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

GIA 5484 (ESM 5464) (PSCI 5484) (CEE 5464):

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

GIA 5504:

Discourse Analysis

Examines the key theoretical sources and major practical applications of discourse analysis as a contemporary social science methodology. Origins, major variants, and critical uses of discourse analysis in cultural studies, semiotic methods, policy analysis, and organizational communication techniqeus also are considered. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

GIA 5554 (ECE 5504) (PSCI 5554) (CS 5504):

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

GIA 5564 (PSCI 5564) (CHEM 5094) (FST 5094) (WS 5564) (BMVS 5094):

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

GIA 5574 (UAP 5574) (PSCI 5574):

Arts, Culture and Society

Considers the role of the arts in society, including architecture, music

companies, or theater productions to heritage sites, science museums, and art galleries. Effective arts policy in revitalizing urban economies also examined. Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

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

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

GIA 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

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

GIA 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

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

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

GIA 6134 (PSCI 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

GIA 6144 (PSCI 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

GIA 6204 (PSCI 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

GIA 6214 (BSE 5044) (BMES 5044) (PSCI 6214) (CHE 5044):
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

GIA 6224 (PSCI 6224) (CHE 5214) (BMES 5434):
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

GIA 6234:
Political Geography of AIDS
Impact of AIDS in terms of scientific, demographic, cultural, and social geographies, particularly how inequalities of power affect populations with AIDS. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

GIA 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

HISTORY

Mark Barrow, Chair

Professors: Linda Arnold; Mark Barrow; Arthur Ekirch; Richard Hirsh; James Robertson; Peter Wallenstein;
Associate Professors: Glenn Bugh; Beverly Bunch-Lyons; Edward Ewing; Hayward Farrar; Kathleen Jones; Marian Mollin; Amy Nelson; Brett Shadle; Neil Shumsky; Robert Stephens; Daniel Thorp;
Assistant Professors: Heather Gumbert; Matthew Heaton; Dennis Hidalgo; Helen Schneider;
Alumni Distinguished Professor: James Robertson;

General Contact: lifounta@vt.edu

Graduate Site: http://www.history.vt.edu/graduate.htm

The Master of Arts program in History provides talented students with advanced training in the professional practice of historical scholarship and pedagogy. The program serves three primary constituencies, preparing students for further graduate work at the doctoral level, for service in a range of public history fields, and for careers as secondary school educators. 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, the serious study of history a foundational discipline in the humanities is a source of intellectual enrichment and a lifelong endeavor. For more information about the graduate program please consult our website: http://www.history.vt.edu/graduate.htm

SPECIAL FACILITIES

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal (600.0), Quantitative, Analytical

The department offers a Master of Arts in History and a Master of Arts in History-Area Studies. Both degrees require a minimum of 30 semester hours of credit. Because research and writing are fundamental tenets of the discipline of History, students are expected to complete a thesis as part of their plan of study. Students who choose the non-thesis option submit a research paper for approval to their advisory committee. For more information about policies and degree requirements see: http://www.history.vt.edu/graduate_students/standards_policies.htm

GRADUATE COURSES (HIST)

HIST 5024 (FOR 5154) (GEOG 5154) (GEOG 5024) (FL 5024):

Area Studies Methods

Introduction to recent theories and methods in history, foreign languages and literary studies, and geography with a focus on issues that have facilitated exchanges between the three disciplines. Practical aspects of Area Studies research are highlighted with particular reference to Latin America, the Caribbean, and Europe. The formulation of research problems using interdisciplinary approaches is given special attention. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

HIST 5144:

The Transatlantic World

Comparative and interdisciplinary study of encounters and exchanges

between Europe, Africa, and the Americas. Surveys the literature on selected topics from the onset of European colonization until the present time.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HIST 5205:
Main Themes in the History of Science and Technology
Methods and concepts in the history of science and technology. 5205: research methods, interpretive approaches, and contemporary issues in the history of science; 5206: research methods, interpretive approaches, and contemporary issues in the history of technology. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HIST 5206 (STS 5206) (GIA 5034) (UAP 5034) (PAPA 5034):
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

HIST 5214 (ASPT 5214) (FOR 5264) (GEOG 5364):
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

HIST 5254:
Topics in Modern European History
Advanced intensive research seminar in the development of European history since the Enlightenment. Variable content course. May be repeated with different topics for credit. II.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HIST 5264:
Readings in Latin American History
Variable topics readings course in Latin American history focusing on intersecting themes such as race/class/gender and environment/technology/culture and emphasizing the most recent trends in the historiography. Students will be expected to write a literature review of recent secondary sources. Variable content course. May be repeated for a maximum of 6 hours.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HIST 5274:
Topics in Latin American History
Variable topics research seminar in Latin American history. Emphasis will be placed on planning a reaearch agenda and analyzing primary sources - visual, oral, and written- within the context of recent trends in the historiography. Students will be expected to write an original article length research paper based on primary sources. 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

HIST 5404:
Development of Modern American Science
Development of the sciences and the community of scientists in the American national context. Emphasis on scientific, institutional, and social events from 1830s through 1980s, including the circumstances surrounding the creation of nuclear weapons and the emergence of "big science." An interdisciplinary perspective, exploring traditional and contemporary historiographical and methodological issues and approaches. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HIST 5414 (STS 6334) (PHIL 6334):
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

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

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

HIST 5504:

Modern European History

Major problems and interpretations of European history from the 18th century to the present. Comparative and theoretical approaches to understanding social movements and transformation, social class and ethnicity, and the politics of culture and "exceptional histories" such as Germany and Russia. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

HIST 5564:

African American Women in United States History

This course is designed to explore the historical, socio-cultural and political forces that have contributed to the development of an African American female experience in the United States. Taught chronologically beginning with the Colonial period, emphasis will be given to the evolution of significant themes, relying on race, class, gender, and regionalism as critical modes of analysis. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

HIST 5614:

Colonial-early National America

Development of America from 1607 to 1828. Emphasis upon social, economic, cultural, and political changes as well as different patterns of regional growth. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

HIST 5644:

Modern Am Since 1920

The transformation of the United States from a powerful but isolated industrial nation with minimal military forces into its current role as industrial and military superpower. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HIST 5674:

Civil Rights Movement

This course will explore the modern U.S. Civil Rights Movement, 1930s - 1960s, a combination of litigation, direct action, and political efforts that sought to eliminate the various facets of Jim Crow, particularly

segregation and disfranchisement, from the nation in general and the South in particular. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HIST 5684:
The U.S. South
A reading colloquium on the history of the south during various periods of its history. Emphasis upon the emergence of the south as a separate and distinct region and the basis of southern identity from the years of slavery to the present. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

HIST 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

HIST 5914:
Race and Slavery in Comparative Perspective
Race and slave societies in the modern world. Emphasis on major themes and developments since the seventeenth century. Comparative and theoretical approaches to understanding slavery in North and South America, the Caribbean, Russia, and South Africa. Concentration on similarities and differences in the slave trade, the origins of racial slavery, and the evolution of slavery as a system of racial oppression. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

HIST 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

HIST 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

HIST 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

HIST 6224:
Science, Technology and the Enlightenment
Science, technology, and medicine and their social and cultural interralationships in the eighteenth and early nineteenth centuries. The modern agenda; nature, knowledge, and progress. Early social science.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HIST 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

HORTICULTURE

James Harris, Head

Professors: James Harris; Joyce Latimer; Richard Veilleux; Gregory Welbaum; Anthony Wolf;

Associate Professors: Eric Beers; Robert McDuffie; Alexander Niemiera; Holly Scoggins;

Assistant Professors: Susan Day; Joshua Freeman; James Tokuhisa; Bingyu Zhao;

Adjunct Professors: Yinghui Dan; Barry Flinn; Zhiwu Li; Joel Shuman; Phillip Wiseman;

Affiliated Faculty: David Close; Laurie Fox; Stephanie Huckestein; Richard Straw;

Julian H. and Margaret S. Gary: Richard Veilleux;

Graduate Contact: rharris@vt.edu

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

The Virginia Tech Department of Horticulture offers programs leading to the Master's and Doctoral degrees. Areas of specialization include: plant breeding and genetics growth and development physiology molecular biology intensification of production through modern cultural practices and innovative approaches urban horticulture The faculty are stationed both on campus in Blacksburg and at several experiment stations throughout the state. Although not all faculty serve directly as advisors to graduate students, all are available as resources to graduate programs.

SPECIAL FACILITIES

On Campus Modern research facilities and several offices are housed in Latham Hall. Offices, a 25-station computer lab, and several classrooms are housed in Saunders Hall. Greenhouse space assigned to the department in the campus greenhouse complex exceeds 20,000 sq. ft. Field research is mostly conducted at the 10-acre Urban Horticulture Center near campus, and the nearby 1,700 acre Kentland Farm contains orchards and vegetable and small fruit plots to support the educational and research efforts of the department. The Hahn Horticulture Gardens and Pavilion is an extensively managed six-acre site on campus that supports some of our teaching and outreach efforts Off CampusFaculty are also located at three agriculture research and extension centers (AREC) across the state. The Alson H. Smith Jr. AREC is located at Winchester and focuses its programs on tree fruits and grapes. The Hampton Roads AREC in Virginia Beach focuses on green industry (nursery and landscape) research and outreach. The Eastern Shore AREC where Horticulture faculty are located in Painter, on the Eastern shore of Virginia, focuses on vegetable research.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal (550.0), Quantitative (600.0)

Minimum Course Requirements for MS (graded classroom hours); advisory committee may require additional 9 - BION, HORT, CSES, PPWS, BIOL (4000-6000 level; 6 hours max of 4000)3 - Advanced statistics (STAT)1 - Intro to Grad Studies (HORT 5104)1 - Hort Seminar (HORT 5004)6 - Additional hours of classroom from above = 20 total6 - 10 - Research and Dissertation (HORT 5994)Total overall hours must = 30An oral defense of a thesis is also required.Minimum Course Requirements for PhD (includes courses accepted from MS); advisory committee may require additional11 - BION, HORT, CSES, PPWS, BIOL (4000-6000 level; 6 hours max of 4000)6 - Advanced statistics (STAT)1 - Intro to Grad Studies (HORT 5104)2 â?? Hort Seminar (HORT 5004)30-70 Research and Dissertation (HORT 5994)Total overall hours must = 90An oral and written preliminary exam and a successful defense of a dissertation are also required.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General: Verbal (550.0), Quantitative (600.0)

Minimum Course Requirements for MS (graded classroom hours); advisory committee may require additional 9 - BION, HORT, CSES, PPWS, BIOL (4000-6000 level; 6 hours max of 4000)3 - Advanced statistics (STAT)1 - Intro to Grad Studies (HORT 5104)1 - Hort Seminar (HORT 5004)6 - Additional hours of classroom from above = 20 total6-10 - Research and Dissertation (HORT 5994)Total overall hours must = 30An oral defense of a thesis is also required.Minimum Course Requirements for PhD (includes courses accepted from MS); advisory committee may require additional11 - BION, HORT, CSES, PPWS, BIOL (4000-6000 level; 6 hours max of 4000)6 - Advanced statistics (STAT)1 - Intro to Grad Studies (HORT 5104)2 - Hort Seminar (HORT 5004)30-70 Research and Dissertation (HORT 5994)Total overall hours must = 90An oral and written preliminary exam and a successful defense of a dissertation are also required.

GRADUATE COURSES (HORT)

HORT 5004:

Seminar

Formal presentation and discussion of current problems, programs, and research studies in horticulture. May be repeated. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

HORT 5104:

Introduction to Graduate Studies and Research

Introduction to topics and processes important during and following graduate study in a Land Grant institution. Topics include philosophy of the Land Grant institution, the scientific process, experiment station project proposals, literature reviews and library information retrieval systems, function of statistics in research, manuscript preparation, oral and poster paper presentation, peer review of manuscripts, grant proposals, and thesis and dissertation preparation. I

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

HORT 5204:

Horticultural Communication in Writing

The business of writing and marketing horticultural publications including magazine, newspaper, and web articles, extension publications, newsletters, manuals, and books. Marketing writing and understanding legal issues. Visual enhancement with illustrations and photographs. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HORT 5304 (CSES 5304):

Advanced Plant Genetics and Breeding

Plant breeding theory and methodology for the improvement of agronomic and horticultural crops; genetic diversity; polyploidy; gene inheritance, expression, interaction, and stability; incompatibility; male sterility; haploidy; genetic engineering and transformation; parental selection, hybridization, and population development; breeding methods, genotypic and phenotypic selection and evaluation; strategies for cultivar development including marker assisted selection and breeding for durable disease resistance. Graduate standing required.

Credit Hour(s): 4

Lecture Hour(s): 3

Instruction Type(s): Lab, Lecture

HORT 5404:

Plant Tissue Culture

The use of aseptic techniques for the culture and manipulation of plant cells, tissues, and organs with emphasis on developmental, physiological, and genetic applications. II

Credit Hour(s): 3

Lecture Hour(s): 2

Instruction Type(s): Lab, Lecture

HORT 5474 (HNFE 5684) (EDHP 5604) (FOR 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

HORT 5504:

Nutrition of Horticultural Crops

Principles of mineral nutrition for the production and utilization of fruits, vegetables, and ornamentals; functions of mineral nutrients, correction of deficiencies and imbalances associated with physiological disorders of usable plant parts; and interactions of mineral nutrients with environmental and cultural factors. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HORT 5524 (PPWS 5524):

Advanced Plant Physiology and Metabolism I

Plant metabolism and its regulation, cell and organ structure and function. Current understanding of photosynthesis, respiration, nitrogen fixation, mineral nutrition, water and ion transport in plant cells and tissues, ecophysiology and responses of plants to the environment. Pre: undergraduate major in Biology or related discipline. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HORT 5534 (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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HORT 5604:

Physiol Crop Plants

Growth and phasic development of crop plants. Emphasis on cellular and metabolic aspects of germination, organ formation, flowering, fruiting, senescence, and the role of environment and bioactive substances. Consent required. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HORT 5654G:

Advanced Viticulture

Overview of Virginia wine garpe industry, grapevine growth and devlopment, and factors affecting yield quality. Vineyard financial considerations, site evaluation, varietal characterists plus cultural practices of pruning, training, canopy management, fertilization and pest management. Pre-requisite: Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

HORT 5764G:

Advanced Vegetable Crops

Advanced topics in vegetable production, post-harvest handling, economic omportance, nutritional value, organic standards, consumption, biotechnology. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

HORT 5784G:

Advanced Vegetable Seeds

Study of vegetable seed production focusing on pollination biology, molecular assessment of seed biology, and current research on seed biology. Seed production, handling, identification, conditioning, enhancement, packaging, storage, testing, fereral standards, and biotechnology.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture, Online Lecture

HORT 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HORT 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

HORT 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study

HORT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

HORT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

HORT 6004:

Advanced Topics in Horticulture

In-depth presentations and discussions in a specific area of advanced horticulture. Topics will vary, and course may be taken for credit more than once. I,II,III

Credit Hour(s): 1 TO 4

Lecture Hour(s): 1 TO 4

Instruction Type(s): Lecture, Online Lecture

HORT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

HOSPITALITY &, TOURISM MANAGEMENT

Richard Perdue, Head

Professors: Mahmood Khan; Ken McCleary; Suzanne Murrmann; Richard Perdue; Muzaffer Uysal; Pamela Weaver;

Associate Professors: Nancy McGehee;

Assistant Professors: Candice Clemenz; Vincent Magnini; Manisha Singal;

Emeritus Faculty: Michael Olsen;

General Contact: htmdpt@vt.edu

General Contact: mdietric@vt.edu

Student Handbook: http://www.htm.pamplin.vt.edu

The Virginia Tech Hospitality and Tourism Management (HTM) graduate program is consistent with the mission of a comprehensive research university; our program emphasizes developing student ability to generate new knowledge through research. HTM is one of six departments in the Pamplin College of Business. Our vision, which permeates throughout our graduate program, is to be the premier business education and research program in hospitality and tourism management. Our graduate program is widely recognized as one of the premier programs of its kind in the nation. Graduates are prepared for challenging careers in academic and/or industry positions in hospitality and tourism management.Two principles permeate our graduate programs. First, one of the most important dimensions of the graduate program is its focus on the application of theories and methodologies from a variety of disciplines to hospitality and tourism management. 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 students' career goals and degree requirements.For graduate students at the Masters level, the program provides an opportunity for growth as a student and as a career-directed individual. The goal is to provide middle management personnel, consultants and researchers to 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.At the Ph.D. level, the program provides an understanding of the body of knowledge in hospitality and tourism management and develops abilities to achieve scholarly success. These abilities include competency in research/problem solving and teaching/communication. Ph.D. candidates are expected to recognize and maintain the highest standards of academic/scholarly performance. The goal of the program is to provide superior educators, researchers and scholars to top tier university programs in hospitality and tourism management. This goal is accomplished by creating a scholarly research environment which makes available to the student opportunities for writing, publishing, research, consulting and teaching.

SPECIAL FACILITIES

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

IELTS: (6.5), (0.0)

iBT: (100.0)

At both the MS and Ph.D. levels, 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 either two (MS) or three (Ph.D.) graduate faculty members. On admission into the graduate program, an initial advisory committee is assigned by the Graduate Program Director. The student has the ability to change this committee after s/he has the opportunity to better know the faculty and articulate her/his interests. The MBA program is administered by the graduate faculty at the National Capital Region campus. The following reflects the general framework of the MS plans of study. Master of ScienceHospitality and Tourism ManagementThesis Option (37 credit hours)15 HOURS in Hospitality Management Core CoursesHTM 5424 Human Resource Management HTM 5444 Financial Management in Hospitality Service Industries HTM 5454 Hospitality Marketing Strategy and Policy HTM 5514 Contemporary Problems in the Hospitality IndustryHTM 5534 Strategic Management and Competitive Strategy in the Hospitality Industries 3 HOURS of StatisticsSTAT 5634 Statistics for Behavioral Science (or other comparable course)3 HOURS of MethodologyHTM 5544 Research Methods for Hospitality Applications9 HOURS in Selected Area of Specialization6 HOURS of Research and ThesisHTM 5994 Research and Thesis1 HOUR of Graduate Seminar in Hospitality and Tourism ManagementHTM 5944 Graduate SeminarMaster of ScienceHospitality and Tourism ManagementNon-Thesis Option (37 credit hours)Those interested in further graduate work after the MS should select the thesis option.15 HOURS in Hospitality Management Core CoursesHTM 5424 Human Resource Management HTM 5444 Financial Management in Hospitality Service Industries HTM 5454 Hospitality Marketing Strategy and Policy HTM 5514 Contemporary Problems in the Hospitality IndustryHTM 5534 Strategic Management and Competitive Strategy in the Hospitality Industries 3 HOURS of StatisticsSTAT 5634 Statistics for Behavioral Science 3 HOURS of MethodologyHTM 5544 Research Methods for Hospitality Applications15 HOURS in Selected Area of SpecializationTo include at least 6 hours of HTM courses plus HTM 5904 Project and Report (3 cr) 1 HOUR of Graduate Seminar in Hospitality and Tourism ManagementHTM 5944 Graduate SeminarNOTE:1. Courses are taken in consultation with the student's advisory committee and approval of the Head of the Department.2. Courses cannot be counted twice under any of the above mentioned categories.3. No more than 9 hours can be taken as independent study courses.4. Consult graduate catalog for the number of courses that can be transferred.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

IELTS: (6.5)

iBT: (100.0)

At both the MS and Ph.D. levels, 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 either two (MS) or three (Ph.D.) graduate faculty members. On admission into the graduate program, an initial advisory committee is assigned by the Graduate Program Director. The student has the ability to change this committee after s/he has the opportunity to better know the faculty and articulate her/his interests. The MBA program is administered by the graduate faculty at the National Capital Region campus. The following reflects the general framework of the Ph.D. plans of study. Ph.D. ProgramHospitality and Tourism Management(90 Credit Hours)The specific courses in the Ph.D. program will be identified in consultation with the student's graduate committee. The general categories of courses are as follows: 12 HOURS: Hospitality Research and Theory CoreHTM 5944 Graduate Seminar (must be taken four times for 3 hours credit)HTM 6434 Theory Development for Hospitality & Service Management HTM 6444 Advanced Quantitative Methods for Hospitality Applications HTM 6464 Review of the Research in Hospitality and Tourism Management 3 Hours: Statistics / Methodology15 Hours: Selected Area of Specialization A minimum of 6 hours must be HTM courses. At least two 6000 level courses.30 Hours Dissertation (HTM 7994)NOTE:1. Courses are taken in consultation with the student's advisory committee and approval of the Head of the Department.2. Courses cannot be counted twice under any of the above mentioned categories.3. No more than 9 hours can be taken as independent study courses.4. Consult graduate catalog for the number of courses that can be transferred.

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

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

HTM 5424G:

Event Mgmt-Soc Sci Perspective

Examines event tourism from a theoretical, sociological, societal, economic and community impact perspective including a review of select theories in the context of event tourism. Addresses multiple event organizational components and event legacy impacts via multiple learning strategies. Utilizes global mega-events such as the Olympic Games and World Cup football as models for discussion. Graduate Standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

HTM 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

HTM 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HTM 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HTM 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

HTM 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HTM 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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

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

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

HTM 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HTM 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

HUMAN DEVELOPMENT

Shannon Jarrott, Head

Professors: Katherine Allen; Rosemary Blieszner; Marcie Boucouvalas; Victoria Fu; Eric McCollum; Peggy Meszaros; Fred Piercy; Karen Roberto;

Associate Professors: Joyce Arditti; Mark Benson; April Few-Demo; Angela Huebner; Shannon Jarrott; Scott Johnson; Kee Kim;

Assistant Professors: Megan Dolbin-MacNab; Mariana Falconier; Christine Kaestle; Jyoti Savla; Cynthia Smith; Andrea Wittenborn;

Affiliated Faculty: Nancy Franz; Kye Kim; Carole McNamee; Bonita Williams;

Alumni Distinguished Professor: Rosemary Blieszner;

Emeritus Faculty: Jay Mancini;

Instructors: Alison Galway;

Research Scientists: Isabel Bradburn;

William E. Lavery Professor: Peggy Meszaros;

Graduate Contact: ksurface@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 NCR 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.

DEGREES OFFERED

MS Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

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

The Human Development Master's program at the Blacksburg Campus requires 30 credits, which includes 6 credits of internship. Each core course includes a Portfolio Project. Students also present at the HD Master's Symposium. The thesis is optional. 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 Northern Virginia campus requires 21 credits. Students Students pursing the master's degree through the Adult Learning and Human Resource Development (ALHRD) program at the National Capital Region Campus complete 33 hours of graduate study and a thesis or project work.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

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

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) 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 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 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

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

HD 5134:

Contemporary Issues in Aging

Seminar that examines literature and research on selected issues in gerontology, such as long-term care, work and retirement, older women, demographic variations of the aging experience, grant writing, intergenerational programs, administration of community based services, and adult education programs.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HD 5144:

Seminar In Gerontology

Introduction to a wide variety of research, policy, and professional issues in gerontology, and programs and services for aged adults. Pass/Fail only.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

HD 5214:

Theoretical Foundations of Child Development

Selected theories related to child development.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

HD 5234:

Cognitive Development: Infancy Through Adolescence

In-depth study of developmental research and theoretical approaches to cognitive development.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

HD 5334:

Theories in Marriage and the Family

Overview of theory construction; in-depth study of various theories of family development and interaction; application of theoretical frameworks to research and analysis of the family; and consideration of the explanatory value of theory when examining the relationship of the family to the larger society. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

HD 5414:

Family Stress and Crisis Intervention

Review of strategies for intervening in crisis situations along with examination of the operation of stress and stress-producing experiences in individuals and families.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

HD 5424:

Life Span Development

Stages of individual development as they occur in the context of the family life course. Overview of current developmental theories. Impact of race, gender, and class on cultural views of developmental norms.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

HD 5464:

Adolescent Development

Advanced study of the physical, cognitive, social and emotional development of the adolescent with emphasis on theoretical issues, research findings, and application of theory and research. Implications for education are highlighted.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

HD 5634:

Legislation and Policy in Human Development

This course provides a context for students to consider in-depth connections between government, policy, and individuals and families throughout the life course. Emphasis is placed on learning through individual study, analysis, and reflection. Students will engage in an advanced exploration of substantive and theoretical issues that relate to the development and implementation of human development policies affecting children, adults, couples, and systems. Portfolio project: Policy analysis paper based on a specific topic, position papers on policy topics. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HD 5644:

Program Development and Evaluation in Human Development

Principles of development, implementation, and sustainability of programs for children, youth, adults, and families, and methodologies used to evaluate program effectiveness. Portfolio project: Program development and program evaluation. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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 activities of a regularly employed professional in the setting accompanied by periodic seminar meetings.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

HD 5714:

Current Topics in Human Dev

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

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

HD 5734:

MFT 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

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

HD 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HD 5964:

Practicum

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

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HD 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study

HD 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HD 5994:

Research And Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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. Pass/Fail only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

HD 6114:

Theory And Research In Aging

Advanced course in gerontology. Review and critique of theoretical constructs and their research applications. Appropriate research designs and procedures for studying development in adulthood and old age. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

HD 6314:

Seminar In Family Studies

Introduction to literature and research in selected areas of family studies.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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

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

HD 6434:

Advanced Diagnosis and Assessment

Comprehensive and advanced study of psychopathology and its assessment and diagnosis from a relational context. The traditional diagnoses of mental disorders are stated in the context of interactional systems, gender, race, and cultures. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

HD 7994:

Research And Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

HUMAN NUTRITION, FOODS, AND EXERCISE

Susan Hutson, Head

Professors: Kevin Davy; Susan Hutson; Janet Rankin; Jay Williams;

Associate Professors: William Barbeau; Susan Clark; Brenda Davy; Paul Estabrooks; Deborah Good; Robert Grange; Dongmin Liu; Eva Schmelz; Elena Serrano;

Assistant Professors: Madlyn Frisard; Jennie Hill; Matthew Hulver; Young Ju;

Jamie Zoellner;

General Contact: hnfeinfo@vt.edu

Student Handbook:

http://www.hnfe.vt.edu/graduate_academics/forms_attachments/graduate_academics_08-09_handbook.pdf

Our mission is to discover, translate, and disseminate health-related advances in the nutrition, food, and exercise sciences. Contribute 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. Provide exceptional training and programs for our students; prepare future professionals who are knowledgeable and committed to life-long learning; produce graduates who are ethical, culturally sensitive, and able to work collaboratively as well as independently; and use rigorous scientific inquiry to create new training programs for undergraduate and graduate students. HNFE was first established in 1960 and has approximately 900 undergraduate students, 57 graduate students, and 34 faculty members (including postdoctoral associates). HNFE offers programs leading to the M.S. and Ph.D. degrees.The Department participates in teaching, research, and community outreach. Faculty in the department generate more than $6 million in research funding from the National Institutes of Health, the U.S. Department of Agriculture, American Heart Association, Muscular Dystrophy Association, National Cancer Institute, American Diabetes Association and the U.S. Department of Defense, as well as a variety of private agencies. HNFE faculty members hold appointments within Virginia Cooperative Extension, providing an opportunity for graduate students to participate in community-based nutrition programs. HNFE provides nutrition assessment and individual and group counseling services to University students, faculty, and staff. This program provides an option for graduate students who wish to develop skills and obtain supervised experience in nutrition counseling and community nutrition education activities. The HNFE faculty enjoys strong collegial relationships with others of similar interests in the Departments of Biochemistry, Animal Science, Food Science and Technology, other departments within the College of Agriculture and Life Sciences, with the College of Veterinary Medicine as well as the Departments of Psychology and Human Development. 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.

SPECIAL FACILITIES

Laboratory facilities available to support graduate student research include: two molecular nutrition laboratories, two muscle function laboratories, a comprehensive body composition laboratory, and two foods laboratories including a sensory evaluation facility. Small animal care facilities are located in Integrated Life Sciences Building I (Building 23) at the CRC to HNFE for student and faculty projects. War Memorial Hall houses the human integrative physiology laboratory and the clinical exercise-testing laboratory. HNFEs partnership with Carilion Clinic has resulted in the Translational Obesity Research Program at Virginia Tech Riverside in Roanoke, which strives to produce a public health impact through physical activity, nutrition, and weight management interventionsThe Department also places considerable effort on generating and disseminating research findings. Research laboratories found in Wallace Hall, War Memorial Hall, and the Corporate Research Center are equipped with state-of-the-art equipment designed for studies ranging from molecular biology to human exercise performance. In addition, exercise activity areas; a heated swimming pool and weight training facilities are available.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

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

Special Degree Requirements All students are required to complete a thesis or dissertation as part of their degree program. Generally, students can complete an M.S. program in two years and a Ph.D. program in three years past the M.S. degree. Entering graduate students in foods and nutrition are expected to have successfully completed undergraduate courses in nutrition, foods, chemistry, the biological sciences, statistics and mathematics. Exercise science applicants must have successfully completed undergraduate coursework in chemistry, physics, the biological sciences, statistics, mathematics and exercise science. No foreign language is required for the M.S. or Ph.D. Behavioral/community students must have successfully completed physical activity, exercise physiology, or kinesiology; nutrition, metabolism, or biochemistry; psychology, sociology, or anthropology; and statistics, epidemiology, or equivalent.

Degree Concentrations:

The Department awards the M.S. and Ph.D. degrees in eight discipline areas. Students may also choose, and are encouraged to integrate two or more disciplines into their course of study. Clinical Exercise Physiology: This option provides training in fitness testing, activity program leadership, health promotion, as well as "hands on" experience with the Therapeutic Exercise and Community Health Center. Individuals with undergraduate training in biology, nutrition, psychology, physical education or health education are well prepared to undertake study in this field. Prior clinical experiences in nursing, respiratory therapy, or physical therapy are also advantageous. Professional positions are available in adult fitness and wellness programs, corporate wellness, and rehabilitative programs for cardiopulmonary patients. Foods:

Coursework and research in this area focus on various aspects of the chemical, sensory, nutritional, and functional quality of food and food ingredients. Specific research areas include lipids, proteins, complex carbohydrates and functional foods. Graduates in this option assume upper level positions in food product research and development in the food industry and food and commodity trade organizations, food consumer education in extension, government agencies, the food industry and food organizations, as well as academic and institutional positions in teaching and research. Human Integrative Physiology: This option prepares students for careers in biomedical science with a primary emphasis in human integrative physiology. Students will receive training in conducting interdisciplinary research which focuses on understanding the mechanisms and consequences of the physiological and metabolic alterations that occur with aging, obesity and/or related cardiovascular and metabolic diseases. The role of physical activity and nutrition in the prevention and treatment of these adverse changes is emphasized. Coursework is designed to build a strong foundation in physiology, metabolism and nutrition but there are also opportunities in biomedical engineering, molecular biology, and genetics. Muscle Physiology and Biochemistry: In this option, students are trained for teaching and research careers in the area of exercise science, specifically muscle physiology, molecular biology, and biochemistry. Emphasis is placed on understanding the short-term and long-term effects of exercise, inactivity, and disease on the functional aspects of the neuromuscular system and skeletal, cardiac and smooth muscle. In addition to course work, research experiences are available in veterinary medicine, animal science, and biochemistry Graduates qualify for positions in universities, industry, and the military. Nutrition: This option focuses on nutrition assessment and metabolic or molecular-biochemical research in a laboratory or clinical setting. Students also choose electives in toxicology, endocrinology, exercise physiology, biochemistry, and metabolism. Nutrition graduates assume positions in the food industry or in companies manufacturing drugs, nutritional supplements, or other medical or health products; research or monitoring activities in government agencies, long term health care facilities, and outpatient clinics; or teaching and research in colleges and universities. Nutritional Immunology & Molecular Nutrition: This option prepares graduates for a successful career in nutrition research and discovery. Participants will receive advanced training in cellular and molecular biology assays. Integrative and interdisciplinary approaches are utilized to investigate gene-nutrient interactions, to assess the safety and efficacy of foods and nutrients, and to elucidate the cellular and molecular mechanisms by which nutrients and nutraceuticals may reduce the risk of chronic diseases such as inflammatory bowel disease, cancer, cardiovascular disease and diabetes. There is also an emphasis on the immunoregulatory mechanisms and molecular targets of naturally occurring fatty acids, sphingolipids, and other bioactive components. Ongoing research collaborations with the Virginia Bioinformatics Institute facilitate access to state-of-the-art genomics and proteomics facilities. Graduates of this option are prepared to assume leadership roles in academia or in the biotechnology industry. Nutrition in Sports and Chronic Disease: This option is designed for individuals who have previous training and experience in either exercise science or nutrition. It provides training in sports nutrition as well as additional courses in the disciplines of nutrition and exercise science to complement individual backgrounds. There is an emphasis on acquiring knowledge and experience with athletes and individuals attempting to prevent chronic diseases such as obesity and cardiovascular disease. Students completing this program find positions in fitness, weight management, athletic clinics/programs, university teaching or research. Behavioral Nutrition & Physical Activity; Discovery to Delivery: This option targets the training of behavioral scientists with a focus on practical applications, dissemination, and implementation of nutrition, physical activity, and obesity interventions that span program, policy, and environmental strategies. Students will acquire proficiency in applied nutrition, physical activity, obesity research and social and behavioral sciences. It will also provide training in the processes and evaluation involved with adoption, implementation, and sustainability of interventions in practice, which will prepare them to work effectively with community and clinical systems and to address diverse audiences. Students learn and apply methods to assess nutrition and physical activity behaviors and community needs and theory-based behavioral interventions. Graduates work on a wide range of issues such as hunger, food security, health promotion, obesity and disease prevention & treatment. This option is developed to produce strong independent research scientists that will be competitive for positions in academic, clinical, or public health research and practice settings.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

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

Special Degree Requirements All students are required to complete a thesis or dissertation as part of their degree program. Generally, students can complete an M.S. program in two years and a Ph.D. program in three years past the M.S. degree. Entering graduate students in foods and nutrition are expected to have successfully completed undergraduate courses in nutrition, foods, chemistry, the biological sciences, statistics and mathematics. Exercise science applicants must have successfully completed undergraduate coursework in chemistry, physics, the biological sciences, statistics, mathematics and exercise science. No foreign language is required for the M.S. or Ph.D. Behavioral/community students must have successfully completed physical activity, exercise physiology, or kinesiology; nutrition, metabolism, or biochemistry; psychology, sociology, or anthropology; and statistics, epidemiology, or equivalent.

Degree Concentrations:

The Department awards the M.S. and Ph.D. degrees in eight discipline areas. Students may also choose, and are encouraged to integrate two or more disciplines into their course of study. Clinical Exercise Physiology: This option provides training in fitness testing, activity program leadership, health promotion, as well as "hands on" experience with the Therapeutic Exercise and Community Health Center. Individuals with undergraduate training in biology, nutrition, psychology, physical education or health education are well prepared to undertake study in this field. Prior clinical experiences in nursing, respiratory therapy, or physical therapy are also advantageous. Professional positions are available in adult fitness and wellness programs, corporate wellness, and rehabilitative programs for cardiopulmonary patients. Foods: Coursework and research in this area focus on various aspects of the chemical, sensory, nutritional, and functional quality of food and food ingredients. Specific research areas include lipids, proteins, complex carbohydrates and functional foods. Graduates in this option assume upper level positions in food product research and development in the food industry and food and commodity trade organizations, food consumer education in extension, government agencies, the food industry and food organizations, as well as academic and institutional positions in teaching and research. Human Integrative Physiology: This option prepares students for careers in biomedical science with a primary emphasis in human integrative physiology. Students will receive training in conducting interdisciplinary research which focuses on understanding the mechanisms and consequences of the physiological and metabolic alterations that occur with aging, obesity and/or related cardiovascular and metabolic diseases. The role of physical activity and nutrition in the prevention and treatment of these adverse changes is emphasized. Coursework is designed to build a strong foundation in physiology, metabolism and nutrition but there are also opportunities in biomedical engineering, molecular biology, and genetics. Muscle Physiology and Biochemistry: In this option, students are trained for teaching and research careers in the area of exercise science, specifically muscle physiology, molecular biology, and biochemistry. Emphasis is placed on understanding the short-term and long-term effects of exercise, inactivity, and disease on the functional aspects of the neuromuscular system and skeletal, cardiac and smooth muscle. In addition to course work, research experiences are available in veterinary medicine, animal science, and biochemistry Graduates qualify for positions in universities, industry, and the military. Nutrition: This option focuses on nutrition assessment and metabolic or molecular-biochemical research in a laboratory or clinical setting. Students also choose electives in toxicology, endocrinology, exercise physiology, biochemistry, and metabolism. Nutrition graduates assume positions in the food industry or in companies manufacturing drugs, nutritional supplements, or other medical or health products; research or monitoring activities in government agencies, long term health care facilities, and outpatient clinics; or teaching and research in colleges and universities. Nutritional Immunology & Molecular Nutrition: This option prepares graduates for a successful career in nutrition research and discovery. Participants will receive advanced training in cellular and molecular biology assays. Integrative and interdisciplinary approaches are utilized to investigate gene-nutrient interactions, to assess the safety and efficacy of foods and nutrients, and to elucidate the cellular and molecular mechanisms by which nutrients and nutraceuticals may reduce the risk of chronic diseases such as inflammatory bowel disease, cancer, cardiovascular disease and diabetes. There is also an emphasis on the immunoregulatory mechanisms and molecular targets of naturally occurring fatty acids, sphingolipids, and other bioactive components. Ongoing research collaborations with the Virginia Bioinformatics Institute facilitate access to state-of-the-art genomics and proteomics facilities. Graduates of this option are prepared to assume leadership roles in academia or in the biotechnology industry. Nutrition in Sports and Chronic Disease: This option is designed for individuals who have previous training and experience in either exercise science or nutrition. It provides training in sports nutrition as well as additional courses in the disciplines of nutrition and exercise science to complement individual backgrounds. There is an emphasis on acquiring knowledge and experience with athletes and individuals attempting to prevent chronic diseases such as obesity and cardiovascular disease. Students completing this program find positions in fitness, weight management, athletic clinics/programs, university teaching or research. Behavioral Nutrition & Physical Activity; Discovery to Delivery: This option targets the training of behavioral scientists with a focus on practical applications, dissemination, and implementation of nutrition, physical activity, and obesity interventions that span program, policy, and environmental strategies. Students will acquire proficiency in applied nutrition, physical activity, obesity research and social and behavioral sciences. It will also provide training in the processes and evaluation involved with adoption, implementation, and sustainability of interventions in practice, which will prepare them to work effectively with community and clinical systems and to address diverse audiences. Students learn and apply methods to assess nutrition and physical activity behaviors and community needs and theory-based behavioral interventions. Graduates work on a wide range of issues such as hunger, food security, health promotion, obesity and disease prevention & treatment. This option is developed to produce strong independent research scientists that will be competitive for positions in academic, clinical, or public health research and practice settings.

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

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

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

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

HNFE 5224:

Proteins and Enzymes in Foods

Physical and chemical properties and reactions of proteins and enzymes in foods. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

HNFE 5614:

Maternal and Child Nutrition

Nutritional needs and problems of pregnant and lactating women, infants, and children in relation to their nutritional physiology; physiological and pathological basis for current research and public health programs in this area are discussed. I

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

HNFE 5624:

Nutrition and Aging

Concepts and principles relevant to nutrition of the aging individual are discussed. Consideration of physiological changes, major nutritional needs, and the application of nutrition principles are included. Human physiology and upper division nutrition course required. I

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

HNFE 5684:

Program Development in Health Education

Theory, trends, and design of community health education programs implemented in communities, health agencies, hospitals, and industry. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

HNFE 5724 (FST 5384) (CHEM 5384) (BMVS 5384) (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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

HNFE 5834:

Metabolic Aspects of Exercise

A study of basic energy and muscle metabolism during exercise and the adaptations which develop through physical training. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

HNFE 5844:

Exercise Testing and Prescription

A study of theory and practice of clinical exercise testing for determination of functional capacity in apparently healthy adults and those with selected chronic diseases, primarily ischemic heart disease. The scientific and clinical basis of prescribing developmental and rehabilitative exercise for these two types of individuals. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

HNFE 5854:

Workshop in Preventive and Therapeutic Exercise

Theory and practice of exercise training for adult fitness and certain chronic disease clients, especially those with ischemic heart disease. Topics include physiology of training, implementation, and monitoring of medically prescribed exercise, leadership techniques, primary and secondary prevention of ischemic heart disease, and program administration. III

Credit Hour(s): 1

Lecture Hour(s):

Instruction Type(s): Lab

HNFE 5874:

Advanced Sports Nutrition

Investigation of the role of nutrition in optimizing physical performance and health of active individuals. Emphasis will be on evaluation of the latest scientific information regarding sports nutrition and translation of this information for athletes and the general public. II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

HNFE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

HNFE 5964:

Field Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HNFE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Independent Study

HNFE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

HNFE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

HNFE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Lecture

HNFE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

INDUSTRIAL AND SYSTEMS ENGINEERING

Gaylon Taylor, Head

Professors: John Casali; Brian Kleiner; Maury Nussbaum; Subhash Sarin; Hanif Sherali; Robert Sturges; Gaylon Taylor; Konstantinos Triantis;

Associate Professors: Ebru Bish; Kimberly Ellis; Lawrence Harmon; Charles Koelling; Thurmon Lockhart; Joel Nachlas; John Shewchuk; Tonya Smith-Jackson; Michael Taaffe; Eileen Van Aken;

Assistant Professors: Michael Agnew; Douglas Bish; Jaime Camelio; Raghu Pasupathy; Hazhir Rahmandad; Christian Wernz; Woodrow Winchester;

John Grado Professor: John Casali;

Paul T. Norton Endowed Professor: Subhash Sarin;

University Distinguished Professor, and W. Thomas Rice Chaired Professor of Engineering: Hanif Sherali;

Charles O. Gordon Professor and Department Head: Gaylon Taylor;

John W. Hancock, Jr. Chair in Engineering & President Emeritus: Paul Torgersen;

Emeritus Faculty: Paul Torgersen;

Associate Professor and Associate Department Head: Eileen Van Aken;

Graduate Admissions Contact: isegrad@vt.edu

Graduate Program Contact: hsswiger@vt.edu

Graduate Site: http://www.ise.vt.edu/graduate/index.php

Main Website: http://www.ise.vt.edu/main/index.php

Student Handbook: http://www.ise.vt.edu/graduate/forms/2009_grad_manual.pdf

Graduate Admissions Information: http://www.ise.vt.edu/graduate/faq.php

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://ise.vt.edu/facilities/index.php

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (400.0), Quantitative (650.0), Analytical (3.5)

MS (thesis) must take 30 hours of coursework beyond the B.S. MS (non-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://www.ise.vt.edu/graduate/ms_hfe.php

Mangement Systems Engineering

http://www.ise.vt.edu/graduate/mse_ms.php

Manufacturing Systems Engineering

http://www.ise.vt.edu/graduate/mfg_ms.php

Operations Research

http://www.ise.vt.edu/graduate/or_ms.php

General Industrial Engineering

http://www.ise.vt.edu/graduate/ie_ms.php

International Degree Program with Ecole des Mines de Nantes

http://www.ise.vt.edu/outreach/international.php

PhD Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (400.0), Quantitative (650.0), Analytical (3.5)

PHD must take 90 hours with a minimum 45 hours of course work beyond the B.S.

Degree Concentrations:

Human Factors Engineering and Ergonomics

http://www.ise.vt.edu/graduate/phd_hfe.php

Manufactuing Engineering

http://www.ise.vt.edu/graduate/phd_mse.php

Management Systems Engineering

http://www.ise.vt.edu/graduate/mse_phd.php This concentration of the PhD program is also offered at the Northern Virginia Graduate Center.

Operations Research

http://www.ise.vt.edu/graduate/or_phd.php

General Industrial Engineering

http://www.ise.vt.edu/graduate/forms/2009_grad_manual.pdf

MEA Degree

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

TOEFL

Paper: (550.0)

iBT: (80.0)

GRE

General: Verbal (400.0), Quantitative (650.0), Analytical (3.5)

MEA must take 30 hours of course work beyond the B.S.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ISE 5606:

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. II

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

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

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

ISE 5616:

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): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

ISE 5634:

Training System Design

A systems approach to the design and development of training, with emphasis on techniques to conduct training-needs analysis; a survey of training technology with an emphasis on computer-assisted techniques and training simulators; and procedures to evaluate training effectiveness.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ISE 5684:

Industrial Health and Safety Engineering

Identification, analysis and control of biological, chemical, electrical, radiation, and fire hazards in industrial settings. Hands-on analysis of several "case-study" projects associated with these hazards in a variety of settings. Recognizing and measurement of hazards, prioritize hazards for control, select effective control methodologies and evaluate the effectiveness of implemented controls.

Credit Hour(s): 4

Lecture Hour(s): 4

Instruction Type(s): Lecture

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

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

ISE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ISE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

ISE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ISE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

ISE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ISE 6984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

ISE 7994:
Research and Dissertation
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

INFORMATION TECHNOLOGY

Parviz Ghandforoush, Head

Professors: Parviz Ghandforoush; Cliff Ragsdale; Tarun Sen;
Associate Professors: Lynn Abbott; Csaba Egyhazy; William Frakes; Devi Gnyawali; Denis Gracanin; Donald Hatfield; Lance Matheson; Luiz Silva; Linda Tegarden;
Assistant Professors: Gregory Kulczycki;

General Contact: vtmitinfo@vt.edu
Graduate Site: http://mit.iddl.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 uses a combination of synchronous and asynchronous communication that 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 five 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.

SPECIAL FACILITIES

DEGREES OFFERED

MIT Degree

Offered In (Virtual)

TOEFL
Paper: (550.0)
Computer: (213.0)
iBT: (80.0)

Thirty credits are required for the Master of Information Technology degree. Each student must complete three of five modules for a total of 18 credit hours, in addition to the four required foundation courses totaling 12 credit hours. Modules include Information Security, Networking, Software Development, Business Information Systems, and Decision Support Systems. The required foundation courses include Object-Oriented Programming with Java, Software Engineering, Fundamentals of Computer Systems, and Strategic Leadership in Technology-Based Organizations. Successful completion of an individual graduate certificate requires between 9 and 12 credit hours in total, consisting of 3-6 credit hours for the relevant foundation course, plus the selected module.

LANDSCAPE ARCHITECTURE

Brian Katen, Head

Professors: Patrick Miller;
Associate Professors: Dean Bork; Terry Clements; Wendy Jacobson; Brian Katen; Paul Kelsch; Mintai Kim; Laurel McSherry;
Adjunct Professors: David Hill; David McGill; Caren Yglesias;
Emeritus Faculty: Benjamin Johnson;
Director 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://archdesign.vt.edu/landscape-architecture/master_of_landscape_architecture

National Capital Region NCR: http://archdesign.vt.edu/programs/waac

Landscape Architecture Program News and Information:

http://www.lar.archdesign.vt.edu/

Ph.D. in Architecture and Design Research:

http://archdesign.vt.edu/architecture-design/phd

Program Information: Graduate Study: Master's in Landscape Architecture, Ph.D. in Architecture and Design Research. See: http://archdesign.vt.edu/landscape-architecture/master_of_landscape_architecture The Landscape Architecture Program at Virginia Tech is committed to discovering, developing, and disseminating knowledge related to the discipline and profession of landscape architecture. Our educational approach stresses discovery-based learning and research, wherein students assume a significant level of responsibility for directing and pursuing their own education and the development of their plan of study. Students and faculty work together to achieve the highest standards of disciplinary and professional preparedness and to develop the capacity for lifelong learning and professional leadership. The Landscape Architecture Program offers three master's degree programs and a Ph.D. Program to meet the diverse needs of prospective students: · Three-year First-Professional Master of Landscape Architecture (NCR/MLA) offered at National Capital Region (NCR) Campus · One and two-year advanced Master of Landscape Architecture (MLA) offered at Blacksburg · Ph.D. in Architecture and Design Research offered at Blacksburg and NCR Our first-professional graduate degree program (NCR/MLA) is fully accredited by the Landscape Architecture Accreditation Board and enables students to become professional landscape architects. Course work in the program provides both a foundation of professional entry-level skills and a level of professional mastery necessary to sustain a successful career, respond effectively to the rapid changes within the profession, and provide leadership to the profession's next generation of practitioners. The advanced MLA and Ph.D. programs are designed for individuals who already hold a professional design degree in landscape architecture or architecture and wish to pursue advanced studies in a particular aspect or research area of the discipline. Students in the Advanced Master's Program build on their professional skills and develop a research and scholarly agenda within an area of focused scholarship.

SPECIAL FACILITIES

Facilities The Land Design & Simulation Lab The Land Design and Simulation Lab conducts studies of the environmental impacts of porposed 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/

DEGREES OFFERED

MLA Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Three-year First-Professional Master's (NCR/MLA): The Master of Landscape Architecture Program (NCR/MLA) is an accredited three-year professional degree designed for individuals who have completed the 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 NCR/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 (CAUS) in Blacksburg. Established in 1998, the program?s location within the National Capital Region enables interdisciplinary collaboration with architecture, natural resources, and urban planning programs and contact with myriad public and private cultural and artistic institutions (e.g. American Society of Landscape Architects, the National Building Museum, the American Institute of Architects, the Library of Congress, and the museums of the Smithsonian Institution). Individuals are admitted to the Master of Landscape Architecture Program on a competitive basis. Applicants, who have completed a four-year 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, a professional undergraduate degree in architecture, 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 review will be conducted to determine 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) and 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 includes 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 culminates with a design thesis directed by a major professor. See: http://archdesign.vt.edu/master-of-landscape-architecture-program-information/3year_first_professional_mla_ncr_mla_program Advanced MLA (2-Year post professional degree, Blacksburg Campus): The Advanced MLA Program is tailored for students who already hold a first professional-degree in landscape architecture or architecture. The Advanced MLA Program is dedicated to the advancement of knowledge and to our understanding of landscape architecture within three "focus study areas" of faculty expertise: Commuity and Place, Ecological

Design, and Design Learning. The focus study areas are intended to differentiate advanced graduate study at Virginia Tech from that at other universities. 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 focus 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. 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. See: http://archdesign.vt.edu/master-of-landscape-architecture-program-information/mla_program_2year_advanced_mla   1 Year Plus Thesis MLA offered at Blacksburg and National Capital Region (NCR) Campus: The 1 Year Plus Thesis MLA Program is an accelerated scholastic degree designed for students who have both a professional degree in landscape architecture 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: http://archdesign.vt.edu/master-of-landscape-architecture-program-information/1year_plus_thesis_mla Dual Degree Program: The simultaneous Master of Landscape Architecture/Master of Urban and Regional Planning (MLA/MURP) is available to students in the MLA Program. MLA/MURP Dual Degree: The MLA/MURP Degree Program features the effective coordination of course requirements in two fields that assures the integrity of each while also saving time and cost to the student. This coordination may consist in the effective sharing of electives and/or the substitution of significantly relevant courses from another field. The MLA/MURP Degree Program recognizes the fundamental linkage between planning and design of the natural environment as impacted by humans. Flexibility through individualized plans of study is accorded students seeking simultaneous degrees based on their backgrounds and needs reflected through individualized plans of study.   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. In the latter case, application to the second program should be made before half the coursework in the first has been completed. A capstone product is required of each program. The capstone product may bridge the fields of each degree. See http://archdesign.vt.edu/landscape-architecture/dual_degrees Study Abroad: With the approval of their major professor, students in the graduate program may take for elective credit the Landscape Architecture Program's Summer Travel Abroad Studio or attend universities with whom the College of Architecture and Urban Studies has cooperative agreements.

PhD Degree

Offered In (National Capital Region, Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

Ph.D. in Architecture and Design Research offered at Blacksburg and National Capital Region (NCR) Campus : Students 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.   See http://archdesign.vt.edu/architecture-design/phd.

GRADUATE COURSES (LAR)

LAR 5004G:

ADV Hist Theory Landscape Arch

Theoretical and practical developments in landscape architecture and related arts through investigation and analysis of design theory and philosophy, and built form. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

LAR 5234G:

Advanced Theory and Practice of Urban Design

Historic and contemporary trends in urban design theory and practice; methods of analyzing urban form; social, cultural, and environmental dimensions of urban design. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

LAR 5244G:

Advanced Landscape Architecture Technology - Hydrology

Examines water resource issues related to landscape planning, site planning and site design. Watershed planning, watershed sensitive site design, estimation of storm water runoff, rainwater conservation, storm water management impact mitigation, design of open channel conveyances, and erosion and sedimentation control. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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

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

LAR 5324G:

Advanced Landscape Architecture Technology III - Construction

Documents

This course links landscape architectural design and construction processes through the production of construction documents for a designed landscape. Landscape technology covered in preceding technology courses is combined with information on construction principles and practices in the preparation of landscape architectural construction drawings and technical specifications. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

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

LAR 5704:

Adv Land Design

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

LAR 5724:

Scholarship in LA

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

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

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

LAR 5964:

Landscape Architecture Field Studies

Credit Hour(s): 1 TO 12

Lecture Hour(s): 1 TO 12

Instruction Type(s): Lecture

LAR 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

LAR 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 9

Instruction Type(s): Lab, Lecture

LAR 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MACROMOLECULAR SCIENCE AND ENGINEERING

Judy Riffle, Head

Professors: Donald Baird; David Dillard; Kevin Edgar; Felicia Etzkorn; Charles Frazier; Richard Gandour; Paul Gatenholm; Harry Gibson; James Heflin; Erdogan Kiran; Donald Leo; Timothy Long; Herve Marand; James McGrath; Joseph Merola; Robert Moore; Judy Riffle; Sam Turner; John Walz;

Associate Professors: Justin Barone; Scott Case; Thomas Cousins; Richey Davis; Paul Deck; Michael Ellis; Alan Esker; Aaron Goldstein; Eva Marand; John Morris; Theresa Reineke; Carin Roberts-Wollmann; Audrey Zink-Sharp;

Assistant Professors: Louis Madsen; Stephen Martin; Mark Paul; Padmavathy Rajagopalan; Scott Renneckar; Maren Roman; Abby Whittington;

Harry C. Wyatt Professor of Chemical Engineering: Donald Baird;

Thomas M. Brooks Professor of Wood Science and Forest Products: Charles Frazier;

University Distinguished Professor: James McGrath;

General Contact: mjsmth@vt.edu

Student Handbook: http://www.mii.vt.edu/MACR/index.html

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 and faculty across the Colleges of Science, Engineering and Natural Resources participate. Students work under the direction of faculty in the departments of Chemistry, Physics, Wood Science and Forest Products, 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, Composites or Civil Infrastructure) to build their 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, teaming 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

DEGREES OFFERED

MS 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: 90Masters of Science (M.S.)* Same core requirement as Ph.D., except 6 credit hours from technical concentration area and 4 credit hours from remaining MACR modules.* MACR 5994: Research and Thesis (minimum of 10 cr.)Total Program Hours: 32Advancement to Candidacy Requirements (Ph.D.)* By the end of the first 12-18 months 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 second year, 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).

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: 90Masters of Science (M.S.)* Same core requirement as Ph.D., except 6 credit hours from technical concentration area and 4 credit hours from remaining MACR modules.* MACR 5994: Research and Thesis (minimum of 10 cr.)Total Program Hours: 32Advancement to Candidacy Requirements (Ph.D.)* By the end of the first 12-18 months 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 second year, 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 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

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

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

MACR 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

MACR 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lab, Lecture

MACR 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MACR 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MANAGEMENT

Anju Seth, Head

Professors: Michael Badawy; Thirwall Bonham; James Lang; Steven Markham; Anju Seth; Richard Wokutch;

Associate Professors: Jeffrey Arthur; Kevin Carlson; Anthony Cobb; Mary Connerley; John French; Devi Gnyawali; Donald Hatfield; Kent Murrmann; Christopher Neck; Wanda Smith; Linda Tegarden;

Assistant Professors: Olga Bruyaka; Steven Gove; Tangela Phillips;

Strickler Professor: James Lang;

Digges Professor: Steven Markham;

Pamplin Professor: Anju Seth; Richard Wokutch;

Graduate Program: kpoe@vt.edu

Graduate Program Director: kevinc@vt.edu

Graduate Program: http://www.management.pamplin.vt.edu/academics/phd/

Ph.D. Program Policies:

http://www.management.pamplin.vt.edu/academics/phd/phd_policies_2007.pdf

The Ph.D. program in Business Administration with a major in Management in the Pamplin College of Business is dedicated to preparing men and women who will be among the next generation of research faculty at top academic institutions. The faculty of the Department of Management is 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. We view a doctoral education as the foundation for a life of learning. We develop excellence in our students that is demonstrated in high levels of productivity as students that position them to make significant scholarly contributions throughout their careers. 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. Our curriculum emphasizes a solid foundation in strategic management, organization theory, organizational behavior, human resources management, and ethics and social responsibility. Students can then specialize in any of these areas for further study. 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 Ph.D. students participate in coursework, special event seminars, research assistantships and one-on-one interaction with graduate student colleagues and a talented and nationally known faculty.

SPECIAL FACILITIES

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

The Ph.D. program in Business Administration with a Major in Management prepares students for an academic career in university research. To be considered for entry into the program students must have completed a Masters Degree, typically an MBA or its equivalent. The doctorate is designed as a residential four-year program that offers a series of foundation seminars that integrate theory and research in strategic management, organization theory, and organization behavior. After completion of basic seminars, students may specialize in any of several management sub-disciplines. Students must also complete a minimum of one semester as a teaching assistant in preparation for their future roles as instructors. The Ph.D. degree in Management requires students to prepare a dissertation and considerable time is spent working toward this degree is devoted to research. Specific requirements for degree completion can be found in the general requirements for the Ph.D. as provided in the sections of this catalog entitled Requirements for the Doctor of Philosophy (Ph.D.) and in the Policies and Procedures for the Ph.D. Degree in Business Administration with a Major in Management

GRADUATE COURSES (MGT)

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

MGT 5334:

Managing Change Through Leadership: Individual and Team Development

This course examines techniques for successfully managing change in formal organizations through a variety of individual and team based methods. Both practical techniques and theoretical perspectives for leadership development will be emphasized within the context of improving organizational effectiveness. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

MGT 5414:

MBA Job Search Strategy

The Success-Related Observable Behaviors (SROB) model will be used to understand role-specific interviews. Also introduced are alternate interview concepts, such as the case interview, industry/field targeted interviews, and panel interview strategy. Legal vs. illegal interview questions and how to respond to them without impairing one's candidacy are covered. Students learn how specific salary offers are determined given a company's job evaluation approach and hiring philosophy. The concept of "basis" for salary negotiation is introduced, as well as appropriate responses to low offers allowing for further negotiation. The ethics of recruitment is addressed, including ethical behavior expectations for candidates, recruiters and career services professionals. MBA students only. Must have completed the first year of MBA core courses.
Credit Hour(s): 1
Lecture Hour(s): 1
Instruction Type(s): Lecture

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

MGT 5434:

Diversity in the Workplace

This course examines the impact of diversity, culture, and ethnic origin on the work experience, and is designed to prepare individuals to meet the challenge of cultural diversity in organizations. Attention is given to how gender, race, religion, age, social class, sexual orientation, culture, tradition, education, economic structure, and organizational philosophy interact to create a set of rules for acceptable behaviors in complex organizations. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MGT 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

MGT 5524:

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

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

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. P/F only Executive MBA students only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

MGT 5644:

Issues in Corporate Governance

Current issues and trends in corporate governance. Topics include overview of the corporation, stakeholder versus shareholder, board of directors, regulatory and legal environment, and executive compensation. Graduate standing in Executive MBA program required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

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. Pass/Fail only

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

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. Pass/Fail only

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

MGT 5694:

Seminar in Current Business Issues

This course will address current issues in business with content changing each time it is offered. Topics may include theoretical, conceptual and practical concerns in business related functions such as accounting, information systems and technology, finance, management or marketing. Executive MBA students only.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

MGT 5714:

Human Resource Staffing and Development

This course is designed to integrate theoretical, legal, and pragmatic considerations pertaining to the acquisition, deployment, and development of human resources within organizations (public and private sector). The course adopts a management perspective in which emphasis is placed on the design and implementation of staffing and development processes to achieve organizational objectives within social and economic constraints.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MGT 5724:

Compensation and Rewards Systems

Study of employee compensation theory and practice in private and public sector organizations. Special emphasis is placed on wage and incentive program design techniques and administrative considerations, and their theoretical justifications.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

MGT 5764:

Applied Human Resource Information Systems

Applied human resource information systems is the study of how human resource information systems (HRIS) can and should be applied in organizations to support organization strategy, improve efficiency and flexibility, increase productivity, and improve the quality of work life for all employees. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

MGT 5824:

Advanced Leadership: Skills & Concepts

This cornerstone course provides innovative experiences, skills, and knowledge in leadership for MBA students. Within an historical context that balances military, political and business perspectives, four types of leadership will be examined: self-leadership, dyadic leadership, team leadership, and enterprise leadership. Special emphasis will be placed on the specific skills, such as computer literacy and project management, required for leaders to succeed in modern, technologically oriented organizations. Pre: Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MGT 5834:

Essentials of Management of Technology

This course focuses on providing MBA students with a thorough understanding of the managerial issues, processes, tools, and skills necessary for the effective organization and management of technology (MOT). The goal is to help students develop an awareness and appreciation of the complex task of managing technology at the micro-level of the organization. An in-depth examination of the nature of MOT as both a discipline and a practice will be emphasized. The course will focus on analyzing the central issues involved in managing the four subsystems of MOT: (1) Research and Development (R&D) Management; (2) Product Technology Management; (3) Process Technology Management; and (4) Intellectual Capital Management. The course's domain will be both the service and manufacturing industrial sectors.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

MGT 5894:

Final Examination

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

MGT 5954:

Study Abroad

Credit Hour(s): 1 TO 6
Lecture Hour(s): 1 TO 6
Instruction Type(s): Lecture

MGT 5964:

Field Study

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

MGT 5974:

Independent Study

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

MGT 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

MGT 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

MGT 6154:

Management Research Methods

Addresses the skill sets necessary to identify and summarize bodies of literature, quantitatively evaluate what has been learned from existing research, and identify research questions that represent the next logical steps in gaining understanding of the outcomes in question. Also examines the impact of research design, statistical methods, and reporting practices on the development of research literature. Pre: 6 Hours of Graduate Statistics

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MGT 6305:

Seminar in Strategic Management

An analysis of activities that fall within the purview of general management and which typically relate to the firm as a whole. Special emphasis is placed on that research dealing with the tasks and responsibilities of general management and currently evolving subjects. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MGT 6306:

Seminar in Strategic Management

An analysis of activities that fall within the purview of general management and which typically relate to the firm as a whole. Special emphasis is placed on that research dealing with the tasks and responsibilities of general management and currently evolving subjects. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MGT 6315:

Seminar in Organization Behavior

A study of the nature of organization behavior and the processes pertinent to organizational effectiveness. The first course deals with the classical theory while the second concerns itself with current research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MGT 6316:

Seminar in Organization Behavior

A study of the nature of organization behavior and the processes pertinent to organizational effectiveness. The first course deals with the classical theory while the second concerns itself with current research.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MGT 6324:

Teaching Ethics and Social Issues

This course provides students with a basic overview of the field of business ethics/social issues in management, including consideration of pedagogical techniques and teaching materials. The purpose of the course is to prepare doctoral students in management to be able to integrate consideration of ethical and social issues in business into the management courses they teach.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

MGT 6325:

Seminar in Organization Theory

A thorough chronological and analytical study of the development of organization theory which concentrates on macro-level organizational

issues from its genesis to the present day. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MGT 6326:

Seminar in Organization Theory

A thorough chronological and analytical study of the development of organization theory which concentrates on macro-level organizational issues from its genesis to the present day. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MGT 6344:

Seminar in Social Issues in Management

Examination of the role of business in society as defined by its relationships with consumers, employees, stockholders, government, and other corporate stakeholders. Emphasis is on examination of and learning to do research on the relationships between business and these stakeholders. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MGT 6364:

Advanced Seminar in Labor Relations

Examination of various aspects of labor relations from both a macro and micro perspective with emphasis on contemporary labor theories and their application inthe labor-management interactions. May be repeated once.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MGT 6374:

Seminar in Advanced Topics in Human Resources Management

A course designed for doctoral students with a special emphasis on existing research and writings which contribute to understanding the constraints and opportunities for effective management of the human resource.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MGT 6384:

Topics in Business Ethics

This course, through coverage of varying topics, is designed to develop knowledge of the moral dimensions of business. Coverage includes major philosophical theories of morality and the place of ethics in business.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

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

MGT 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

MGT 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MARKETING

Kent Nakamoto, Head

Professors: David Brinberg; James Littlefield; Kent Nakamoto; Julie Ozanne; Mack Sirgy;

Associate Professors: Eloise Coupey; Noreen Klein;

Assistant Professors: Rajesh Bagchi; Elise Ince; Jane Machin; Yael Rugar; Kimberlee Weaver;

R.B. Pamplin Professor of Marketing, Dept. Head, Associate Dean of Research: Kent Nakamoto;

Robert O. Goodykoontz Professor of Marketing: David Brinberg;

Sonny Merryman Inc. Professor of Marketing: Julie Ozanne;

Graduate Contact: jeblanke@vt.edu

Graduate Site:

http://www.marketing.pamplin.vt.edu/academics/graduate/index.html

Doctoral Program in Marketing:

http://www.marketing.pamplin.vt.edu/academics/graduate/phd.html

Marketing grows out of the concept of exchange between buyers and sellers. Driven by the needs and wants of the consumer, marketing managers develop new products and services as well as marketing programs to guarantee that they reach business customers and ultimately, the consumer. And managing marketing is growing even more exciting as technology and the internet enable managers to stay in closer contact with their customers and better manage this relationship. The Department of Marketing in the Pamplin College is dedicated to providing outstanding academic opportunities for undergraduate, masters, and doctoral students. The undergraduate program supports over 700 students pursuing a marketing major, making it one of the most popular majors in the College. Our highly selective M.S. and Ph.D. programs are designed to offer interested students focused research opportunities as well as technical training. M.S. OverviewThe Marketing Department offers a focused Master of Science program with a concentration in 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 organizations. 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. 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 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

Center for Marketing and Consumer Health This research group in this center will apply marketing theories and methods to improve consumer health. Faculty in the center will examine a wide range of issues, particularly at the interface of consumer decision-making, technology, and public and social policy. The center will facilitate the coordination of joint research projects among the participating faculty and with other potential collaborators across other units on campus. Forest Industries Center at Virginia Tech: A Sloan Foundation Industry CenterThe Department of Marketing, which has assumed the leadership role for the Pamplin College's participation in this center, has been ranked in the nation's top 20 marketing departments in research productivity. Marketing faculty members have conducted numerous research projects to examine inefficiencies in the "seedlings-to-goods" supply chain and have published papers in the area of wood products.

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 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.

PhD 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 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

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

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

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

MKTG 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

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

MKTG 5554:

Business Marketing Management

Business marketing is a course designed to familiarize the student with the environmental framework and major managerial problems in businesses marketing to other businesses, nonprofit organizations, governments, and those in other countries. It is also the purpose of this course to acquaint the student with the professional and operational literature of business marketing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MKTG 5564:

Marketing of High Technology

This course covers the unique nature of demand for high tech products and applies the basic elements of marketing strategy--market segmentation and targeting, marketing mix elements--to the context of high technology. It also addresses the development of effective strategic, marketing plans for high technology goods and services. Pre: permission of instructor I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

MKTG 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MKTG 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MKTG 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

MKTG 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

MKTG 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

MKTG 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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

MKTG 6984:

Special Study

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

MKTG 7994:

Research and Dissert

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

MATERIALS SCIENCE AND ENGINEERING

David Clark, Head

Professors: David Clark; Norman Dowling; Diana Farkas; Louis Guido; Robert Hendricks; Guo Quan Lu; William Reynolds; Dwight Viehland;

Associate Professors: Alexander Aning; Levon Asryan; Sean Corcoran; Peizhen Lu; Gary Pickrell; Shashank Priya;

Assistant Professors: Abby Whittington;

Research Faculty: Diane Folz; Jie-Fang Li; Sean McGinnis; Carlos Suchicital;

Adjunct Professors: Michael Bortner; Shuxiang Dong; Dudley Finch; M Julian; Stephen Kampe; Michael Kelley; Kathryn Logan; Ben Poquette;

Affiliated Faculty: Romesh Batra; Christine Burgoyne; Scott Case; Rafael Davalos; James Heflin; Jerry Hunter; Donald Leo; Herve Marand; Mitsuhiro Murayama; Khai Ngo; Marie Paretti; Scott Renneckar; Thomas Staley; Roe Yoon;

Clifton C. Garvin Professor: Romesh Batra;

Graduate Contact: grandska@vt.edu

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

Application Instructions:

http://www.mse.vt.edu/GraduatePrograms/ApplicationInstructions/tabid/707/Default.aspx

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.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. 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.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.

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. 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.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.

PhD 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. 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.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

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

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

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

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

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

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

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

MSE 5104:

Composite Materials

The application of the fundamental concepts of mechanics, elasticity, and plasticity to multiphase and composite materials. Constitutive equations for the mechanical and physical properties of metal, ceramic, and polymeric matrix composites. The role of processing and microstructure on properties. An undergraduate degree in engineering or science is required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

MSE 5134:

High Temp Materials

Recovery and creep behavior of metals and ceramics at elevated temperatures. Microstructural modifications during creep, effect of microstructural variables on creep, and fracture at elevated temperatures. Stress and temperature dependence of creep rates. Time-temperature correlations for temperature-variant conditions.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

MSE 5184:

Materials Modeling and Simulation

Computer modeling and simulation of diffusional and diffusionless processes active in the microstructural development of engineering materials; including spinodal decomposition, precipitation, sintering, ordering, grain growth, martensitic transformations, and ferroelectric and ferromagnetic domain evolution. Thermodynamics and kinetics of phase transformations; analytical and numerical mathematical methods; diffuse interface field approach; multi-physics modeling; multi-scale modeling.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MSE 5200 (ECE 5200):

Semiconductor 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

MSE 5214:

Optoelectronic and Magnetic Applications

This course will introduce the field of man-made modifications in the properties of materials obtained by controlled growth of structures of nearly atomic dimensions. Devices which utilize these properties will be studied. The course will emphasize the relationships between advanced materials growth technologies, new materials properties, physics concepts and new devices. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MSE 5224:

Photonic Materials

An introduction to materials used in the generation, propagation and harnessing of light for useful applications. An emphasis on understanding the structure of materials including glasses, single crystals, and polycrystalline materials, and their effects on the propagation of electromagnetic energy. Luminescence (including phosphorescence and fluorescence), refractive index, transmission, absorption, reflection, origin of color in materials, fiber optics, dispersion, nonlinear effects, lasers, LEDs, detectors, numerical aperture, attenuation coefficients, Rayleigh scattering, infrared absorption spectra, holey fibers, and photonic crystals. Undergraduate degree in engineering or science is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MSE 5254:

Science and Technology of Thin Films

Fundamental properties and microstructure of materials in thin film (thin coating) form, their interaction with a substrate, thin film processing/characterization techniques, and instrumentation. Areas of application have been selected to exemplify the interdisciplinary nature of the field and include the electronics, biomedical, military, aerospace and construction industries. Undergraduate degree in engineering or physical sciences is required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

MSE 5504:

Polymer Deformation and Fracture

Continuum, statistical and molecular response of polymers under mechanical loading conditions. Molecular determinations of modulus, molecular and mechanical mechanisms of crazing and crack propagation, analytical methods relating molecular, micromechanical and mechanical response in polymers.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

MSE 5624:

Design of Materials

The design of materials through the application of microstructural based structure/property relationships. Emphasis on the use of phenomenological and theoretical structure-property-processing relationships as means to guide material design. The influence of scale (nano, micro, meso, macro) on property development and material behavior. Pre: Graduate standing and/or an undergraduate physical sciences or engineering degree.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MSE 5634:

Design with Materials

The role and implications of material properties, processing, and structure in engineering design. The role of material selection in the conceptualization, specification, and implementation phases of the design process. Case studies in state-of-the-art, material-limiting component design. Graduate standing required and an undergraduate physical sciences or engineering degree.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MSE 5654:

Adhesion Science

Introduction to basic principles of adhesion science from the areas of mechanics, materials, and chemistry. Consent required. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MSE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MSE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

MSE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

MSE 5994:

Research And Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

MSE 6304:

Advanced Topics in Materials Science

Advanced topics selected from the technical literature that stress the development of fundamental concepts and/or technologies of contemporary interest to materials science and engineering. Topics will vary; may be repeated for credit.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MSE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MATHEMATICS

Peter Haskell, Head

Professors: Slimane Adjerid; Joseph Ball; Christopher Beattie; Jeffrey Borggaard; Ezra Brown; John Burns; Martin Day; William Floyd; George Hagedorn; Peter Haskell; Jong Kim; Martin Klaus; Werner Kohler; Tao Lin; Peter Linnell; Carl Prather; Frank Quinn; Michael Renardy; Yuriko Renardy; Robert Rogers; John Rossi; David Russell; Mark Shimozono; Shu Ming Sun; James Turner; Robert Wheeler;

Associate Professors: Eric De Sturler; Serkan Gugercin; Traian Iliescu; Peter Wapperom;

Assistant Professors: Alexander Elgart; Nicholas Loehr; Anderson Norton; Pengtao Yue; Lizette Zietsman;

Affiliated Faculty: Imran Akhtar; John Burkardt; Qinian Jin; Reinhard Laubenbacher; Yiqiang Li; Henning Mortveit;

Alumni Distinguished Professor: Ezra Brown;

Hatcher Professor of Mathematics: John Burns;

Class of 1950 Professor: Michael Renardy; Yuriko Renardy;

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 Ph.D. degrees. Both traditional and interdisciplinary options are available for the M.S. degree. Details about the M.S. and Ph.D. degree options can be found in our graduate program policies document available at http://www.math.vt.edu/grPolicies.pdf.The 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 Transport Theory and Mathematical Physics (CTTMP), the Center for Mathematical Computation (CMC), the Interdisciplinary Center for Applied Mathematics (a University research center), and the Virginia Bioinformatics Institute. Please visit the Department of Mathematics at http://www.math.vt.edu for more information.

SPECIAL FACILITIES

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. M.S. degrees are available under thesis and non-thesis options. Under 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 nonthesis 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 program 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 program of study at the very outset of his/her graduate studies.Hour Requirements: For any of the degree options, the student's Program of Study must show 30 hours. The courses which make up these 30 hours must meet the constraints indicated in the "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 Ph.D. requires the completion of 90 hours, of which between 30 and 60 must be research and dissertation (7994). At least 27 hours must be mathematics courses (excluding research and dissertation) numbered 5000 or higher. Up to 42 hours of transfer credit can be used, subject to the advisory committee's approval and Graduate School guidelines. Courses used toward the M.S. in mathematics may be used toward the Ph.D. as well. More information about the specific requirements for the Ph.D. 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5125:

Abstract Algebra

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5126:

Abstract Algebra

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5135:

Topics in Number Theory

Advanced topics in number theory such as algebraic number theory, analytic number theory, or theory of quadratic forms.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

MATH 5214:

Specialized Topics in Analysis

Various graduate level topics in analysis for graduate students in mathematics and qualified students in other areas. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5225:

Real Analysis

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5226:

Real Analysis

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5245:

Ordinary Differential Equations

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5246:

Ordinary Differential Equations

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5415:

Specialized Topics in Applied Math

Various graduate level topics in applied mathematics for graduate students in mathematics and qualified students in other areas. May be taken for credit more than once with department consent. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5416:

Specialized Topics in Applied Math

Various graduate level topics in applied mathematics for graduate students in mathematics and qualified students in other areas. May be taken for credit more than once with department consent. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. IV

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5454:

Graph Theory

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5464:

Combinatorics

Counting problems, generating functions, recurrence relations, principle of inclusion and exclusion, experimental designs. Consent required. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MATH 5474 (CS 5474) (BCHM 5344) (PPWS 5344):
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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

MATH 5495:
Mathematical Methods in Engineering I,ii
Linear algebra and matrix theory, vector calculus, complex variables and integral transforms, ordinary and partial differential equations, special functions, integral equations and calculus of variations. Facility with an existing math software package knowledge of senior level engineering mathematics required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

MATH 5496:
Mathematical Methods in Engineering I,ii
Linear algebra and matrix theory, vector calculus, complex variables and integral transforms, ordinary and partial differential equations, special

functions, integral equations and calculus of variations. Facility with an existing math software package knowledge of senior level engineering mathematics required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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. III

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

MATH 5725:

Mathematics for Financial Modeling

Introduction to stochastic models used in financial market analysis and associated computational methods. 5725: Brownian motion, stochastic integration, Ito calculus, martingales, no-arbitrage pricing, Black-Scholes formula, basic term-structure models. 5726: PDE characterizations for American, Asian and various other path-dependent options, development and application of numerical methods for computation. Must meet pre-requisites or have instructor's consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5726:

Mathematics for Financial Modeling

Introduction to stochastic models used in financial market analysis and associated computational methods. 5725: Brownian motion, stochastic integration, Ito calculus, martingales, no-arbitrage pricing, Black-Scholes formula, basic term-structure models. 5726: PDE characterizations for American, Asian and various other path-dependent options, development and application of numerical methods for computation. Must meet pre-requisites or have instructor's consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5754:

Introduction to Perturbation Methods

Asymptotic expansions and series, approximate solutions of algebraic equations, straightforward expansions and their regions of nonuniformities, the Lindstedt-Poincare technique, the method of renormalization, the method of averaging, the method of matched asymptotic expansions. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

MATH 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

MATH 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MATH 6125:

Topics in Algebra

Advanced topics in algebra for graduate students in mathematics. May be taken for credit more than once with department consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 6126:

Topics in Algebra

Advanced topics in algebra for graduate students in mathematics. May be taken for credit more than once with department consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 6225:

Topics in Analysis

Advanced analysis for graduate students in mathematics. May be taken for credit more than once with department consent. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 6226:

Topics in Analysis

Advanced analysis for graduate students in mathematics. May be taken for credit more than once with department consent. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

MATH 6425:

Top in Applied Math

Advanced topics in applied mathematics for graduate students in mathematics, science, and engineering. May be taken for credit more than once with department consent. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 6426:

Topics in Applied Mathematics

Advanced topics in applied mathematics for graduate students in mathematics, science, and engineering. May be taken for credit more than once with department consent. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 6755:

Mathematical Foundations of Quantum Mechanics

Advanced course in mathematical physics which encompasses the frontiers of research in quantum theory. Content varies from year to year and includes scattering theory, spectral and perturbation theory, and many-body quantum dynamics. This course frequently taken concurrent with thesis research. The course alternates with Math 6745-6746 and may be taken a second time with instructor's consent. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 6756:

Mathematical Foundations of Quantum Mechanics

Advanced course in mathematical physics which encompasses the frontiers of research in quantum theory. Content varies from year to year and includes scattering theory, spectral and perturbation theory, and many-body quantum dynamics. This course frequently taken concurrent with thesis research. The course alternates with Math 6745-6746 and may be taken a second time with instructor's consent. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

MATH 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MECHANICAL ENGINEERING

Kenneth Ball, Head

Professors: Mehdi Ahmadian; Kenneth Ball; Richard Benson; Eugene Brown; Ricardo Burdisso; Thomas Diller; Christopher Fuller; Daniel Inman; John Kennedy; Gordon Kirk; Andrew Kurdila; Donald Leo; Roop Mahajan; Douglas Nelson; Wing Fai Ng; Walter O'Brien; Ranga Pitchumani; Janis Terpenny; Uri Vandsburger; Michael von Spakovsky;

Associate Professors: Francine Battaglia; Javid Bayandor; Jan Helge Bohn; Clinton Dancey; Srinath Ekkad; Michael Ellis; John Ferris; Tomonari Furukawa; Hampton Gabler; Warren Hardy; Dennis Hong; Scott Huxtable; Mary Kasarda; Alan Kornhauser; Brian Lattimer; Alexander Leonessa; Rolf Mueller; Mark Paul; Mark Pierson; Shashank Priya; Michael Roan; Corina Sandu; Steve Southward; Danesh Tafti; Saied Taheri; Brian Vick; Pavlos Vlachos; Robert West; Alfred Wicks;

Assistant Professors: Jeremiah Abiade; Bahareh Behkam; Amrinder Nain; Christopher Rylander; M Rylander; Christopher Williams;

Research Faculty: Tahereh Hall; Kevin Kochersberger;

Adjunct Professors: Reiner Anderl; Per Brolinson; James Funk; Manfred Hampe; Douglas Rabe;

L.S. Randolph Professor: Kenneth Ball;

Paul & Dorthea Torgresen Chair: Richard Benson;

Roanoke Electric Steel Professor in Engineering: Christopher Fuller;

George R. Goodson Professor: Daniel Inman;

W. Martin Johnson Professor: Andrew Kurdila;

Tucker Chair Professor of Engineering: Roop Mahajan;

Christopher C. Kraft Professor of Engineering: Wing Fai Ng;

John R. Jones III Professor: Ranga Pitchumani;

J. Bernard Jones Professor: Walter O'Brien;

Emeritus Faculty: Leon Arp; Robert Comparin; Norman Eiss; Michael Furey; Roger Hedgepeth; Charles Hurst; James Jones; Robert Leonard; James Mahan; William Mashburn; Larry Mitchell; Reginald Mitchiner; John Moore; Arvid Myklebust; Thomas Parkinson; Felix Pierce; Adorjan Szeless; James Thomas; William Thomas; Robert Whitelaw;

General Contact: megrad@vt.edu

Graduate Coordinator: hillcath@vt.edu

Graduate Chair: maryk@vt.edu

ME Department Site: http://www.me.vt.edu

ME Graduate Studies Guide: http://www.me.vt.edu/academic_programs/graduate/guide.html

ME Research Centers and Labs: http://www.me.vt.edu/research.html

Bursar's Office: 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://graduateschool.vt.edu/financial/insurance/

Fellowships and Scholarships: http://graduateschool.vt.edu/financial/fellowship_scholarship/index.html

Dates & Deadlines: http://graduateschool.vt.edu/academics/dates_deadlines/index.html

College of Engineering: http://www.eng.vt.edu/

Housing: http://graduateschool.vt.edu/student_life/student_handbook/housing.html

New Student Handbook: http://graduateschool.vt.edu/admitted/index.html

Graduate Student Veterans: http://www.veterans.vt.edu/Graduate_Students/index.html

The mission of the graduate program in Mechanical Engineering at Virginia Tech is to prepare students to advance the practice of mechanical engineering, and to expand and apply the body of knowledge that comprises the discipline of mechanical engineering for the benefit of our students, research sponsors, the technical community, and ultimately our society. This mission is accomplished through the high-quality instruction, guidance, and mentoring of our graduate students. With over fifty faculty members, the Department of Mechanical Engineering offers advanced study and research in a wide range of areas leading to the 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. The plan of study includes courses appropriate to the student's individual interests and research needs. Courses within the department that reflect many of the research focus areas include topics on fuel cell systems, nuclear engineering, biomedical topics, acoustics, active materials/smart structures, propulsion, thermodynamics, nanotechnology, automatic controls, rotor dynamics, turbomachinery, fluid dynamics, combustion, heat transfer, finite elements in machine design, and vibrations among other subjects. Students often take courses from outside the department in mathematics, statistics, and many other disciplines, both in the College of Engineering and in other colleges.The Mechanical Engineering Department also has an international collaboration with the Technische Universität Darmstadt for a dual Master of Science degree. Pending approval by the Virginia Tech governance system, a Nuclear Engineering Certificate will be available for students to pursue, in conjunction with their graduate degree program. Specific requirements will be posted once the certificate is approved.

SPECIAL FACILITIES

To facilitate research advances, the department has a number of specialized laboratories housing a substantial collection of sophisticated instrumentation and equipment. These laboratories include an anechoic chamber, a reverberation room, a gas turbine test cell, a fuel cells systems laboratory, a mechatronics laboratory, a rapid prototyping laboratory, a thermal radiation laboratory, a computer-aided design laboratory, a combustion laboratory, impact biomechanics laboratory, and a laser dynamics imaging laboratory among others. Many of these laboratories support one or more of the seven research centers and 19 laboratory groups which are headquartered in the department. A list of Centers and research groups are listed below, including links to the web sites.

Advanced Experimental Thermofluids Engineering Research Laboratory

The Advanced Experimental Thermofluids Engineering Research Laboratory (AEThER). AEThER specializes in the development and application of advanced and novel experimental fluid mechanics methods for spatio-temporally resolving complex thermo-fluids systems.

Advanced Vehicle Dynamics Laboratory

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.

Biotransport & Optics Laboratory

The mission of the Biotransport and Optics Lab is to engage in translational research at the intersection of biomedical tissue optics, device design, and heat and mass transport.

Center for Automotive Fuel Cell Systems

The mission of the Center for Automotive Fuel Cell Systems is to promote and facilitate education and research in the area of systems and components for transportation applications of fuel cell systems.

Center for Energy Systems Research

The mission of the Center for Energy Systems Research is to promote and facilitate education and research in the energy domain and to impartially serve the citizens of the Commonwealth of Virginia, the nation, and the international community by assisting them with energy issues.

Center for Injury Biomechanics

The 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

The 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 Turbomachinery and Propulsion Research

The Center for Turbomachinery and Propulsion Research (CTPR) at Virginia Tech has provided research and educational service to industry and government agencies for nearly 30 years.

Center for Vehicle Systems & Safety

Center 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 anlysis.

Design, Research & Education of Additive Manufacturing Systems Laboratory

The 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.

EXTREME Laboratory

The EXTREME Laboratory is an interdisciplinary laboratory where experimental and computational research is performed on material response at high temperatures and loads as well as combustion and fire dynamics processes.

High Performance Computational Fluid Thermal Science and Engineering Group

The 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 fluid-thermal flows.

Hokie Heat Transfer Laboratory

The Hokie Heat Transfer Laboratory conducts research by using experimental heat transfer methods, enhanced heat transfer for turbine blade cooling, external surface heat transfer and film cooling for turbine blades, blade tip leakage flow and heat transfer, micro air vehicles, micro-channel heat exchangers, and fuel cell design and analysis

Intelligent Transportation Laboratory

The 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. The facilities are located in Danville, Virginia at the Institute for Advanced Learning and Research:Â www.ialr.org.

Micro/NanoScale Biotic/Abiotic Systems Engineering Laboratory

The mission of the Micro/NanoScale Biotic/Abiotic Systems Engineering Laboratory (MicroN BASE) is to study and understand actuation, sensing and control mechanisms of microorganisms and apply the findings to design and fabricate biologically integrated and/or inspired microscale engineering systems.

Modal Analysis Laboratory

The Modal Analysis Laboratory specializes in research relating to the characterization of dynamic properties of structures.

Multi-Phase Flow Laboratory

The Multiphase Flow Laboratory is dedicated to basic and applied research aimed at improving our understanding of multiphase flows. Our research has concentrated on single-component liquid-vapor flows for energy conversion systems.

Performance Engineering Research Laboratory

The 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.The PERL facility is located in Danville, Virginia at the Institute for Advanced Learning and Research: www.ialr.org.

Railway Technologies Laboratory

The 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 & Mechanisms Laboratory

The Robotics & Mechanisms Laboratory (RoMeLa) at Virginia Tech is a facility for graduate and undergraduate robotics research and education with an emphasis on studying novel mobile robot locomotion strategies.

Rotor Dynamics Laboratory

The Rotor Dynamics Laboratory is involved with both analysis and experimental evaluation of rotating machinery design and vibration.

Unmanned Systems Laboratory

The 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

The mission of the Vehicle Terrain Performance Lab (VTPS) is to improve vehicle system performance by studying the interactions between vehicles and terrain. The facility is located in Danville, Virginia at the Institute for Advanced Learning and Research: www.ialr.org.

Vibrations & Acoustics Laboratory

The Vibrations and Acoustics Laboratory's (VAL) is one of the seven centers in the Mechanical Engineering Department. VAL's mission is to devote our research facilities to the solution of major scientific problems and to improving the quality of life in the communities that we serve. One of our primary goals is to provide a foundation of knowledge, expertise and leadership in the field of sound and vibration control.

Virginia Active Combustion Control Group/ Reacting Flows Lab

The Reacting Flows Lab and the Virginia Active Combustion Control Group (RFL/VACCG) coexist with the joint purpose of better understanding combustion and flow phenomena.

DEGREES OFFERED

MEng Degree

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

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GRE

General Test: Verbal (450.0), Quantitative (700.0), Analytical (550.0), Analytical Writing (4.5)

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 people 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: Engineering project and report (ME 5904): 6 hours minimum 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: 6 hours minimum A maximum of two Virginia Tech 4000 level courses can be used to meet degree requirements. 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. 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 or Independent Study courses.

PhD Degree

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

TOEFL

Paper: (620.0)

Computer: (260.0)

iBT: (105.0)

GRE

General Test: Verbal (450.0), Quantitative (700.0), Analytical (550.0), Analytical Writing (4.5)

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. 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, 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 4000 level courses. 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, the doctoral student 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 Students may enroll directly from the Bachelors to the PhD by applying for "Direct-PhD". 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.The Nuclear Engineering Graduate Certificate is pending approval.

MS Degree

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

TOEFL

Paper: (620.0)

iBT: (105.0)

GRE

General: Verbal (450.0), Quantitative (700.0), Analytical (4.5)
German Language

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 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. 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. No courses below the 4000 level will be accepted for graduate credit.International VT-TUD Universität Dual Master of Science DegreeThe Virginia Tech-Technische Universität Darmstadt (VT-TUD) Dual Master of Science Degree requires that the student complete one year at each university, for a total of 45 semester credit hours of coursework and 15 semester credits of thesis and research. The coursework at TUD is in German and the thesis is written in English. MS degree requirements for both Virginia Tech and the Technische Universitat Darmstadt must be completed to receive the diplomas from each university. Refer to the ME Graduate Studies Guide for degree requirements.

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.eduThe Nuclear Engineering Graduate Certificate is pending approval.

GRADUATE COURSES (ME)

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

ME 5135 (AOE 5135) (GIA 5116) (PSCI 5116):

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

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

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

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

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

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

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

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

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

ME 5506:

Advanced Control Engineering

Unification of the analysis and design techniques of a broad range of dynamic systems through the use of the tools of modern control. Builds upon the background of classical control topics including Nyguist, Bode, and root locus. Emphasis upon developing the tools of state-space control theory and applying these tools to effect the design of controllers for linear dynamic systems. 5506: Transform analysis and design of systems with digital and continuous components. Classical and modern treatments along with discussion of quantization effects. Design problems with hands-on experience.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ME 5544 (ECE 5744) (AOE 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

ME 5554 (AOE 5754) (ECE 5754):

Applied Linear Systems

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ME 5574 (AOE 5774) (ECE 5774):

Nonlinear Systems Theory

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

ME 5654:

Modeling and Simulation of Multibody Dynamic Systems

Develops basic mathemathical 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

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

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

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 Universität 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

ME 5714 (BMES 5514) (CEE 5244) (BSE 5244):
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

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

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

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

ME 5754 (STS 6314) (PHIL 6314) (BMES 5164) (BMES 6164):
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

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

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

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

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

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

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

ME 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

ME 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

ME 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

ME 6404:

Turbulence and Turbulent Flow

Nature and origin of turbulence, turbulent transport of momentum and heat, dynamics of turbulence, theoretical and statistical approaches, closure schemes. Analysis of turbulent flows including gird-generated turbulence, free shear flows, and wall-bounded flows. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ME 6405:

Advanced Internal Flow

Conservation equations and constitutive relations, exact Navier Stokes solutions; boundary layer approximation and special solutions; approximate methods; compressibility and heat and mass transfer effects; numerical methods, turbulence models. 6406: selected topics on recent activities in the fluid dynamics research community, including theory, analysis, and computational modeling. Specific topics will vary depending upon the instructor's areas of expertise.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

ME 6434 (AOE 6434):

Computational Fluid Dynamics and Heat Transfer

Overview of numerical methods used in the study of computational fluid dynamics (CFD) and heat transfer. Spatio-temporal finite-difference, finite-volume discretizations, solution of linear systems with direct and iterative methods, algorithms for solving the Navier Stokes and energy equations, and turbulence modeling. Applications to inviscid subsonic, transonic, and supersonic flows and viscous boundary layer. Theory reinforced with hands on programming assignments and the application of commerical CFD packages to select problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ME 6504:

Topics in Advanced Control Applications

Timely subjects in applications of control theory. Topics to be chosen from include optimization, adaptive control, learning control, and non-linear analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ME 6544 (ECE 6744) (AOE 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

ME 6574 (AOE 6774) (BMVS 5454) (VM 8034) (ECE 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

ME 6624:

Adv Fin Elem Applic

Advanced application of the finite element method to mechanical design problems. Nonlinear analysis techniques; geometric nonlinearity, material behavior elastic and inelastic response, moving boundary conditions, multi-component contact problems. Dynamic response analysis; direct integration, mode superposition. A semester finite element analysis/design project is a significant part of the course. Must have prerequisite or an equivalent linear finite element background. Taught alternate years. I.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ME 6704:

Acoustic-Structural Interaction

The fundamental principles underlying the coupled vibration of structures and their radiated sound field will be outlined. Methods for analytically investigating the motion of elastic structures surrounded by acoustic mediums will be studied. Beam, plate, and cylindrical shell structures will be considered. Application of the methods developed to various situations encountered in practice and research will be studied. An introduction to the boundary element method will be presented. I,II.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

ME 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

Instruction Type(s): Lecture, Online Lecture

ME 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MICROBIOLOGY GRADUATE TRAINING PROGRAM

Professors: Stephen Boyle; Jiann Shin Chen; Dennis Dean; Patricia Dove; Joseph Falkinham; Charles Hagedorn; Thomas Inzana; Charles Johnson; Peter Kennelly; Timothy Larson; Liwu Li; Xiang-Jin Meng; David Popham; Nammalwar Sriranganathan; Ann Stevens; Erik Stromberg; Susan Sumner; Sue Tolin; Zhijian Tu; Brett Tyler; Gregory Welbaum; Keith Yoder;

Associate Professors: Kathleen Alexander; Eric Beers; Joseph Eifert; Chuanxue Hong; Katharine Knowlton; John McDowell; Stephen Melville; Biswarup Mukhopadhyay; Sally Paulson; Jean Peccoud; Amy Pruden-Bagchi; Paul Roberts; Robert White; Robert Williams; Zhaomin Yang;

Assistant Professors: Zachary Adelman; Renee Boyer; Marcy Hernick; Michael Klemba; Tanya LeRoith; Isis Mullarky; Kevin Myles; Monica Ponder; Florian Schubot; Pablo Sobrado; Elankumaran Subbiah; Boris Vinatzer; Lijuan Yuan; Bingyu Zhao;

General Contact: dpopham@vt.edu

General Contact: Dennie@vt.edu

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

The study of the biology of microorganisms has a long tradition at Virginia Tech. In fact, the first advanced degree given at the university was awarded in bacteriology in 1891. If you are searching for a university where you can enhance your scientific career by undertaking postgraduate research toward a PhD degree, you will find that Virginia Tech can offer you exciting and rewarding options. There are a large number of Virginia Tech faculty members carrying out research with microorganisms. These faculty members are located in several different departments and their locations reflect to a large extent the diversity of their research interests. You will find research being carried out in microbial ecology; in the relationship of microorganisms to diseases in plants, animals, and humans, as well as to bioterrorism and emerging diseases; in the problems associated with microorganisms in food; in the many roles microorganisms play in agriculture; and in the fundamental nature of the microbial cell, to name just a few. (Faculty Research Interests)Due to the diverse nature of Microbiology research, students accepted into the VA Tech Microbiology Graduate program have the opportunity to spend "lab rotation" time in three different research labs around campus during their first semester. They then choose the lab in which they will carry out their Ph.D. dissertation research and enter the graduate program of that department. All students admitted into the program are supported with a monthly stipend with tuition fully paid.

SPECIAL FACILITIES

In addition to individual faculty research labs, there are many common research resources available across campus. Some of those are listed here: Electron Microscopy/Morphology Service Laboratory (http://www.vetmed.vt.edu/Organization/Research/Resources/morphology.asp) Flow Cytometry Resource Laboratory (http://www.vetmed.vt.edu/Organization/Research/Resources/flow.asp)

Fralin Fermentation & Protein Purification Facility (http://www.biotech.vt.edu/research/fermentation.html) Keck Confocal Microscope Facility (http://www.biotech.vt.edu/research/keck_microscope.html) Virginia Tech Mass Spectrometry Incubator (http://www.mass.biochem.vt.edu/maldi.php) Virginia Bioinformatics Institute Core Laboratory Facility (https://www.vbi.vt.edu/core_laboratory_facility) Core Computational Facility (https://www.vbi.vt.edu/article/articleview/88)

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal+Quantitative (1000.0)

The Virginia Tech Interdepartmental Microbiology Program offers training in all areas required for the development of successful scientists. Research:During your first semester you will perform research rotations in three laboratories, chosen from a broad range of topic areas. Following those rotations, you will come to a mutual choice with a faculty member to enter their lab and complete your dissertation research. The average time for students to complete the Ph.D. program is 5 years.Teaching and Presentation skills: All graduate students are required to spend at last one semester as a graduate teaching assistant, generally supervising an undergraduate teaching laboratory.All students have numerous opportunities to develop their presentation skills under non-stressful conditions. First year students give short 10-minute talks describing their research rotation projects. More advanced students present seminars describing their research projects or related topics. Students are expected to participate in lab group meetings and journal clubs to present and discuss the most recent research methods and discoveries. All this prepares the student to present their research at national and international research conferences.Coursework:The plan of study for each student is based on their prior experience and their future interests. Students are required to complete 18 graded credit hours in advanced courses (generally 6 courses). Students will take 2-3 courses each semester of their first year and 1-2 courses each semester in their second year. The remainder of their time is spent in the research labs. In addition to the courses listed below, each year there are several specialized courses offered that examine the most recent research advances within various fields of study.BCHM 5054 Molecular Biology of Prokaryotic Gene RegulationBCHM 5115-5116 Principles of BiochemistryBCHM 5204 Molecular Biology of Eukaryotic Gene ExpressionBCHM 5214 Molecular Biology of the CellBIOL/CSES/CEE 4164 Environmental MicrobiologyBIOL (FST) 4604 Food MicrobiologyBIOL 4644 Microbial Molecular Genetics and Physiology LaboratoryBIOL 5664 Advanced VirologyBIOL 4704 ImmunologyBIOL 5984 Innate Immunity/InflammationBIOL 4714 Immunology laboratoryBIOL 5804 Advanced Prokaryotic DiversityBIOL 5624 Advanced Microbial GeneticsBIOL 5634 Advanced Microbial PhysiologyBIOL 5674 Advanced Pathogenic BacteriologyBIOL 6634 Topics in Microbial EcologyBIOL 6644 Topics in Microbial GeneticsBIOL (PPWS)6654 Topics in VirologyBIOL (VMS)6704 Topics in ImmunologyCEE 5194 Applied Biology of Environmental SystemsFST 5604 Advances in Food MicrobiologyPPWS 5054 Plant Pathogenic AgentsPPWS 5204 Principles of Plant Disease ManagementPPWS 5214 Diseases of Crop PlantsVMS 5024 Selected Topics in Veterinary Pathogenic BacteriologyVMS 5044 Veterinary ImmunologyVMS 5054 Veterinary Virology

MINING ENGINEERING

Gregory Adel, Head

Professors: Gregory Adel; Michael Karmis; Gerald Luttrell; Roe Yoon;

Associate Professors: Mario Karfakis; Erik Westman;

Assistant Professors: Kramer Luxbacher; Emily Sarver;

A. T. Massey Professorship: Gerald Luttrell;

Nicholas T. Camicia Professorship and University Distinguished Professor: Roe Yoon;

Stonie Barker Professorship: Michael Karmis;

Graduate Contact: dewk@holdendomain.com

Graduate Site: http://www.mining.vt.edu/academics/graduate.htm

Student Handbook: http://www.mining.vt.edu/academics/GradStudentManual.pdf

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 research and development. The degrees prepare graduates for successful careers in industry, academia, and government. Graduate research may be pursued in several areas of specialization including rock mechanics, ground control, equipment evaluation, systems analysis, health and safety, mineral and coal processing, applied surface and colloid chemistry, conservation and the environment, mining ventilation, mine electrical systems, computer applications, and mineral economics. One or more of the topics may be emphasized within the department at a given time based on the ongoing research activity of the eight full-time research faculty members assigned to the department. Graduate students accepted to the program are generally provided financial support through sponsored grants, teaching assistantships or graduate fellowships. The graduate program also recognizes the specific needs of industry professionals with a program that strives to (i) upgrade technological skills of practicing engineers, (ii) encourage the pursuit of doctoral-level work, and (iii) provide an opportunity for advanced education and career reorientation. 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.

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 rock mechanics, mine ventilation, health and safety, advanced earth systems instrumentation, mine automation and control, mineral processing and applied surface and colloid chemistry. The laboratories are supported by a well-equipped mechanical shop managed by skilled technicians. The following is a listing of laboratories currently operated and maintained by the department.

Department Facilities

The following is a listing of laboratories currently operated and maintained by the department. Rock Mechanics 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. Mine Ventilation Laboratory: The facilities in the mine ventilationÂ laboratory inlcude 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. The laboratory is also equipped with a high performance computer for CFD simulations using Fluent software. Two gas chromatographs are also housed in the laboratory capable of detection by electron capture detector (ECD), thermal conductivity detector (TCD) and flame ionization (FID) for analysis of tracer and mine gases. Health and Safety Laboratory: The facilities in the health and safety laboratory include capability for gas/dust analysis and noise monitoring. Earth Systems 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.Ã?Â 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. Mineral Processing Laboratories: The facilities in mineral processing include various types of crushing and grinding equipment; complete pilot-plant with a ball mill, flotation banks, flotation columns, a thickener, a filter and ore bins, conveyors, belts, and pumps. Equipment for particle characterization includes a vast array of analytical instruments for particle size and mineralogical/elemental analysis.Ã?Â In addition, an entire suite of coal analysis equipment is available for determining proximate analysis, sulfur, Btu and ash fusion temperature. 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. 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.

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)

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)

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)

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 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

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

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

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

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

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

MINE 5054:

Computer Applications and Modeling of Mining Operations

Applications of computer programs to the modeling and estimation of ore reserves, the scheduling and planning of mine activities, the optimization of mine production, and the design and selection of equipment and support systems. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

MINE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

MINE 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

MINE 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

MINE 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

MINE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

MOLECULAR PLANT SCIENCES

James Westwood, Program Director

Professors: Elizabeth Grabau; Ruth Grene; Chuanxue Hong; Charles Johnson; Mohammad Saghai-Maroof; Brett Tyler; Richard Veilleux; Brenda Winkel;

Associate Professors: Eric Beers; Amy Brunner; Erin Dolan; Glenda Gillaspy; John Jelesko; Christopher Lawrence; John McDowell; Vladimir Shulaev; Boris Vinatzer; James Westwood; Chenming Zhang;

Assistant Professors: Eva Colla'kova'; Jason Holliday; Sakiko Okumoto; Guillaume Pilot; David Schmale; Dorothea Tholl; James Tokuhisa; Yiheng Zhang; Bingyu Zhao;

Graduate Contact: dennie@vt.edu

Graduate Site: http://www.molplantsci.org.vt.edu/

The Molecular Plant Scientists at Virginia Tech welcome you. We are a group of more than twenty faculty and many more students in seven departments in the Colleges of Agriculture, Science, and Natural Resources. All of us use molecular approaches to understand how plants grow and interact with their environments. Our Graduate Program in Molecular 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.Degree candidates who enroll in the program will participate in several rotations through laboratories of interest. The program of study will include 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 student then will become a doctoral student in the advisor's home department. (eg. Biochemistry, Forestry, Horticulture, etc.) Thus, the student will receive the doctoral degree from that specific department.The diversity in our programs becomes evident 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.

SPECIAL FACILITIES

Latham Hall was dedicated in 2006. This 84,000-square-foot, state-of-the-art agriculture and natural resources research facility, provides greatly expanded and fully outfitted laboratory space, a large number of controlled-environment chambers, soil and plant material preparation areas, conference rooms, and faculty offices.

Latham Hall

Latham Hall was dedicated in 2006. This 84,000-square-foot, state-of-the-art agriculture and natural resources research facility, provides greatly expanded and fully outfitted laboratory space, a large number of controlled-environment chambers, soil and plant material preparation areas, conference rooms, and faculty offices.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

All Ph.D. students must pass a preliminary exam and a final exam. Procedures and requirements for completing these exams are contained in your specific department's Graduate Program Procedures and the Graduate Catalog. 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 molecular plant sciences. The student may be tested on any aspect of relevant science, 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 is primarily a defense of the dissertation, but other areas of science may be included.

NATURAL RESOURCES

Visiting Faculty: Brian Czech; Shelley Mastran; Jennifer Plyler; David Robertson;

Adjunct Professors: Milagros Alvarez; Michael Champ; Desiree DiMauro; Heather Eves; Laura Giese; Stephanie Gripne; John Hadidian; Jane Huff; Jeannine Mantz; Michael Ruggiero; R Sampson; Steven Sheffield; Shirlee Tan; Ann Wood-Arendt; Ann Wood-Arendt; Dequn Zhou;

Affiliated Faculty: Kieran Lindsey; Michael Mortimer; Alan Thornhill;

Director: Michael Mortimer;

Visiting Asst. Professor: Alan Thornhill; David Trauger;

Emeritus Faculty: David Trauger;

Associate Director, NRDLC: Kieran Lindsey;

General Contact: nrstaff@nvc.vt.edu

Program Director: mortimer@vt.edu

Graduate Site: nr.ncr.vt.edu

Graduate Site: http://cnre.vt.edu/xmnr/

The Vision Our vision for the Northern Virginia Natural Resources Program is to be a leader in the areas of natural resource policy, sustainable development of urban environments, and the sustainable management of natural resources on adjacent rural lands-both public and private.Program DescriptionVirginia Tech is well positioned to reach this goal, as our expertise in the College of Natural Resources and Environment is not duplicated by any other university with a presence in Northern Virginia. We have established a teaching/research/outreach program focusing on Sustainable Natural Resources In Rapidly Urbanizing Environments. We intend to address the complex ecological issues related to land and natural resources in the rural-urban transitional environment in Northern Virginia, one of the most rapidly developing areas in the United States. As the population of Virginia grows, urbanization will place increasing pressure on rural lands and natural resources. The challenge will be to satisfy the need for developed land while conserving natural resources and the benefits they bring to the citizens of the Commonwealth. Also, increased urbanization will bring the challenges of managing natural resources in a new setting. How to balance natural resources and human needs in urban and urbanizing landscapes is emerging as the central question confronting community leaders, resource managers, land use planners, landscape architects, engineers, park managers, and many others. Conflicts between developers and conservationists are escalating as competition for land and other resources intensify. In addition, resource-based industries are facing economic impacts from urbanization, e.g., decline in commercial fisheries in the Chesapeake Bay. As our use of land for urban and suburban development increases, traditional natural resources values are either reduced or lost. As a result, we must find ways to maintain and restore ecologically significant habitats and processes in and around urban areas. We must also abandon the myth that wildlife and other living resources can be relegated to the countryside and kept separate from the "built and landscaped environment" of the city. Communities and corporations are becoming aware that maintaining a close connection between people and the natural environment is a vital component contributing to "quality of life" and "sense of well-being." In response, there is a growing awareness across the United States of the need for proactive management for urban natural resources. States, counties, and cities are hiring urban resource professionals, enacting legislation, and implementing programs to create harmony between natural resources and people who inhabit our communities. However, there are emerging concerns that the proliferation of urban natural resources programs is extended beyond the existing scientific underpinnings for sound resource management and conservation. Thus, this nexus of development pressures and conservation interests provides tremendous challenges as well as unique opportunities. The Natural Resources Program in Northern Virginia focuses on these emerging information and policy needs in urban and urbanizing environments. While traditional natural resource education, research, and outreach programs have addressed issues involving rural environments, our program addresses natural resource issues in the urban environment as well as in the growing urban/rural interface. Issues such as urban fisheries and wildlife management, urban forestry, open space management, greenways and blueways, land use policy, water allocation, and sustainable development are included. As remote sensing and geographic information systems are important tools in managing natural resources, we also incorporate Virginia Tech's expertise in this area. The teaching portion of our program includes at least two courses per semester leading to a Certificate of Graduate Studies in Natural Resources. In addition, a non-thesis degree, the Master of Natural Resources (MNR) is available for students in Northern Virginia. The research component of our Northern Virginia program will focus on natural resources policy-in a broad sense-with emphasis on urban forestry and wildlife, as well as issues related to sustainable urban development. As we expand our program and add additional members to the faculty, the research component will expand into other related areas. Our research will be multidisciplinary in scope and interdisciplinary in approach. Studies will be conducted in collaboration with other Virginia Tech departments, as well as appropriate partners in Federal, Commonwealth, County, and City government agencies. The outreach component of the program will include short-courses, workshops, and seminars on urban wildlife management, urban forestry, bioenergy, effects of urbanization on instream flow and aquatic resources, and geographic information system applications to urban land management and planning.

SPECIAL FACILITIES

Classes are offered at the Northern Virginia Centers in Falls Church and Alexandria, as well as remotely to sites in Blacksburg, Richmond, and Danville.

DEGREES OFFERED

MNR Degree

Offered In (Virtual, National Capital Region)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

MNR must take 33 credit hours, including 4 core courses (12 credit hours); and prepare a research-oriented capstone paper (3-6 credit hours). Certificate of Graduate Study in Natural Resources requires 4 courses (12 credit hours) and must incldue NR 5724 (Consevation Ecology).

GRADUATE COURSES (NR)

NR 5004:

Graduate Seminar in Natural Resources

Advanced exploration of special topics in natural resources through guest speakers, student/faculty presentations, small group projects, and critical reviews of pertinent literatures. Topics and format vary depending on interests of faculty and graduate students. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

NR 5014 (FIW 5014) (FOR 5014):

Constructing Sustainablity

Synthesize ecological, economic, and social dimensions of sustainable and resilient systems. Examine history, theory, current status, and future prospects of sustainablity 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

NR 5044:

Environmental Conservation and the American Landscaape

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

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

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, ploitics, 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

NR 5224:

Field Biology and Ecology

Field study of wild flora and fauna in natural habitats with special emphasis on composition, structure, function and processes of ecosystems in the mid-Atlantic states. Methods and techniques used in field biology. Demonstration and application of field methods. Graduate standing required. National Capital Region students only.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

NR 5234:

Landscape Ecology

Landscape interactions between spatial patterns and ecological processes. Concepts, theories, and methodologies that illustrate spatial pattern importance for understanding landscapes interactions. Focuses on spatial relationships among landscape elements; flows of energy, mineral nutrients, and species among the elements; and ecological dynamics of the landscape mosaic through time. Explores landscape ecology from natural to urbanizing landscapes at scales associated with urban issues. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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 rsource 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

NR 5364:

Private Lands Conservation Policy

Past and current public policy and program development on private farm and forest lands are studied in light of the issues influencing their evolution, management, and administration. Historical lessons and ecological concepts are applied to analysis of current policies and programs. Primarily taught at the National Capital Region. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

NR 5374:

Endangered Species Policy and Management

Holistic assessment of endangered species policy and management in the United States, focusing on the Endangered Species Act of 1973 as amended. Topics covered will include legislative history, policy design principles, and various technical issues, especially species prioritization and agency implantation. This course will also address the socioeconomic context of endangerment, including the politics of species conservation, ESA and democracy, ESA in the courts, and ecological economics of species conservation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

NR 5414:

Urban Forest Management and Policy

Planning, designing, developing, managing, and maintaining trees and associated natural resources in urban and suburban environments. Ecological, socio-cultural, economic, and political components of urban forestry management and policy. Primarily taught at National Capitol Region. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

NR 5644:

Interdisciplinary Recreation Planning

Outdoor recreation planning at community, state and federal land management unit scales. Explores strategies for integrating outdoor recreation in public land planning processes, accommodating other land use demands and disciplines within the planning area. Emphasizes contemporary, comprehensive, recreation planning tools. Introduces participatory leadership in a comprehensive, interdisciplinary, planning proces. Defines roles and theories of interdisciplinary team leader and team player. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

NR 5654:

Outdoor Recreation Design and Development

Design and development of facilities for interpreting outdoor recreation to public lands users in locations from wilderness to urban areas. Focus on team approaches to comprehensive design and development from initial project identification, planning, interpretation and development through project design, construction, operations, and maintenance. Primarily taught at National Capital Region. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

NR 5674:

Public Lands and Realty Principles

Organization, legislative structure, and legal policy for managing public land real estate. Principles for land status records, boundary maintenance, withdrawal processing and title claim settlements. Focuses on legal concepts, critical analysis, problem solving, and original thinking, including interactions with land management agencies and with professional organizations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

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

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

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

NR 5894:
Final Examination
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

NR 5954:
Study Abroad
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

NR 5964:
Field Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

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

NR 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 10
Instruction Type(s): Lab, Lecture, Online Lecture

NR 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

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

NR 6314:
Advanced Topics in GIT
Literature, case study, and hands-on coverage of advanced topics in the fields comprising geographic information technology: geographic information systems, remote sensing, and the Global Positioning System, selected to cover emerging techniques and technologies, those too specialized to form components of the regular curriculum. Includes discussion of GIT tools as they fit into the domain of Natural Resources and general scientific inquiry. Application topics differ each semester. May be repeated. Recommended prerequisites: GEOG/GEOS 4354
Credit Hour(s): 0 OR 3
Lecture Hour(s): 0 OR 2
Instruction Type(s): Lab, Lecture

OCEAN ENGINEERING

Robert Canfield, Head

Professors: Alan Brown; Robert Canfield; William Devenport; Christopher Hall; Rakesh Kapania; Joseph Schetz; Roger Simpson;
Associate Professors: Wayne Neu; Christopher Roy; Craig Woolsey;
Assistant Professors: Mazen Farhood; Leigh McCue-Weil; Mayuresh Patil; Michael Philen; Gary Seidel; Cornel Sultan;
NAVSEA Professor of Naval Ship Design: Alan Brown;
Norris & Laura Mitchell Professor of Aerospace Engineering: Rakesh Kapania;
Fred D. Durham Endowed Chair: Joseph Schetz;
Jack E. Cowling Professor: Roger Simpson;

Graduate Contact: aoegradcoordinator@vt.edu
Student Handbook: http://www.aoe.vt.edu/graduate/forms/grad-policies-procedures-09-30-10.pdf

Graduate Site: http://www.aoe.vt.edu/graduate/index.html

Masters of Science Degree Overview 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 multidiciplinary 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 Overview 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 Overview 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 multidiciplinary 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

Two space dynamics-related laboratories exist at Virginia Tech. The Space Systems Simulation Laboratory includes two spherical air bearings with approximately 150kg payload each, and allows experimental verification of algorithms and control laws involved in the large-angle, three-dimensional motion of rigid and flexible bodies using internal and external torques, along with distributed control and inter-satellite communications. The Satellite Tracking Laboratory is an education-focused lab, and includes computers and an amateur satellite ground station. Students in space-related courses can perform a variety of experiments involving actual satellites, aimed at strengthening their understanding of space dynamics, state estimation, motion prediction, and space physics, and the effects these principles have on the design and operation of spacecraft. The 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. Founded by Dr. Craig Woolsey and Dr. Naira Hovakimyan in 2005, the NSL is now co-directed by Dr. Woolsey and Dr. Cornel Sultan. The NSL is a Core Laboratory in the Virginia Center for Autonomous Systems (VaCAS).The Structures Lab 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 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 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.This facility includes a unique moving end-wall system, consisting of a belt that moves beneath the blade tips to simulate the relative motion between blades and casing found in a real turbomachine. The layout of the moving endwall system is shown above. The moving wall is a continuous flat belt driven by rollers at speeds of up to 25m/s. The belt is made from 0.01"-thick Mylar film. The width of the belt is 27". The total length of the belt is about 25' . The belt is driven by a 8" diameter high precision flat-surface roller. Another 8" diameter crowned surface roller is used to adjust and keep the position of the belt. The driving rollor is powered by a 15-horse power AC motor. A digital motor controller is used to control the rotating speed of the motor by changing the output frequency. The belt is supported by a flat Teflon coated bed. Several slots cut into the bed provide suction to hold the belt on the bed, restricting its vertical vibration to a few microns. 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.

DEGREES OFFERED

MS Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

A. Master of Science Requirements: Thesis and (Non-Thesis) 1. A minimum of 30 credit hours is required, of which up to 10 (0 for non-thesis) credit hours may be allotted for research and thesis (AOE 5994) credit. (Non-thesis students may use AOE 5904: Project and Report if they will complete their M.S. requirements with a project and report). 2. A minimum of 12 (15 for non-thesis) credit hours (excluding thesis, AOE 5994) of course work numbered 5000 and higher must be included in the Plan of Study. This does not include the AOE Seminar. 3. A maximum of 6 (9 for non-thesis) credit hours of Independent Study (5974) and Special Study (5984) is allowed. 4. A maximum of 6 credit hours of 4000 level courses approved for graduate credit is allowed. 5. Up to 50% of the courses on the Plan of Study may be transferred, subject to approval of the Advisory Committee. 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 5104, Advanced Aero and Hydrodynamics; § AOE 5334, Advanced Ship Dynamics; § AOE 4404, Numerical Methods; and § AOE 5074, Advanced Ship Structural Analysis*. *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. In addition, students must take 9 (18 for non-thesis) credit hours from any of the following approved electives as a requirement. Non-thesis students must take two of the following courses: § AOE 5034, Vehicle Structural Dynamics; § AOE 5044, Dynamic Stability of Structures; § AOE 5374, Rationally-Based Design of Ocean Structures; § AOE 5144, Boundary Layer Theory and Heat Transfer; § AOE 5454, Advanced Aerospace and Ocean Engineering Instrumentation; § AOE 4024, An Introduction to the Finite Element Method; or § AOE 4344, Dynamics of High Sped Craft. 7. If a student has previously taken, while a Virginia Tech 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. Any required AOE course may be replaced only with another AOE course. 8. Courses in which a student is deficient upon entering the program must be made up in a manner which satisfies the Advisory Committee. 9. All course work that appears on the Plan of Study must have been taken within the five years previous to time of submission of the Plan, or must be completed within five years after the time of submission of the plan. Any course which exceeds these limits must be validated by examination.

MEng Degree

Offered In (Virtual, Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

B. Master of Engineering Requirements: 1. The M. Engr. 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). 2. A minimum of 30 credit hours is required, of which 3-6 credit hours must be allotted for AOE 5904: Project and Report. 3. A minimum of 15 credit hours (including 5974 and 5984) of 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 courses is allowed. 5. A maximum of 9 credit hours of Independent Study (5974) and Special Study (5984) is allowed. 6. Up to 50% of the courses on the Plan of Study may be transferred and are subject to approval of the Advisory Committee. Each transferred course must have a grade of B (3.0/4.0) or better. 7. A minimum of one approved Mathematics course is required. 8. All M. Engr. candidates are required to take: § AOE 5104, Advanced Aero and Hydrodynamics; § AOE 5334, Advanced Ship Dynamics; § AOE 4404, Numerical Methods; § AOE 5074, Advanced Ship Structural Analysis*; and § One additional AOE course. *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. 9. 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. 10. Courses in which a student is deficient upon entering the program must be made up in a manner which satisfies the Advisory Committee. 11. All course work that appears on the Plan of Study must have been taken within the five years previous to time of submission of the Plan, or must be completed within five years after the time of submission of the plan. Any course which exceeds these limits must be validated by examination. 12. 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).

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

AOE 5034 (ESM 5304) (HNFE 5694) (PHS 5044):

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

AOE 5044:

Dynamic Stability of Structures

Modern structural stability analysis; static and dynamic instability; conservative and nonconservative systems; multiple loads; and Liapunov stability analysis. Applications to columns, rotating shafts, pipes conveying fluid, and airplane panels. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AOE 5054 (CEE 5454) (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

AOE 5064 (ESM 5064):

Structural Optimization

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

AOE 5135 (ME 5135) (GIA 5116) (PSCI 5116):

Vehicle Propulsion

Aeothermodynamics 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

AOE 5136:

Vehicle Propulsion

Aeothermodynamics 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

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

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

AOE 5214:

Aircraft Dynamics and Control

General equations of aero/hydrodynamic vehicular motion including the effects of flexibility and changing mass. Consideration of buoyant, aerodynamic, gravitational and thrust forces, jet damping, thrust offset, and rotating machinery contributions. Reduction of equations to linearized form, aero/hydrodynamic stability derivatives. Stability and

response characteristics. Application of classical control theory to aircraft control.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

AOE 5306:

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

AOE 5314:

Naval Ship System Design

Overview of the ship design process, and insight into the major factors which influence the technical trade-offs governing the synthesis of a ship design. The course is directed primarily at systems engineers, equipment engineers (hull, machinery and combat systems), and technical managers who interface with the ship design community. The course is also of value to practicing naval architects who desire a broad perspective into the ship integration process. (NAVSEA site only). Undergraduate engineering degree required. I,II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

AOE 5344:

Nonlinear Control of Mechanical Systems

Methods of nonlinear control, emphasizing techniques applicable to mechanical systems. Nonlinear system theory and stability analysis. Nonlinear controllability and observability. Input-output properties. Passive and dissipative systems and stability of interconnected systems. Common nonlinear control design techniques: feedback linearization; sliding mode control; adaptive control. Techniques for mechanical systems: potential shaping; kinetic shaping. Emphasis on applications to vehicle control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

AOE 5504:

Aerospace and Ocean Engineering

Introduction of the natural space environments: solar wind, planet atmosphere, ionosphere, magnetosphere, comets, and meteoroids. Introduction of the induced spacecraft environments. Advanced treatment of the physics and effects of atmospheric interactions, plasma interactions, radiation interactions, hypervelocity impacts, spacecraft contamination, and interactions induced by electric propulsion. Applications to spacecraft design. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

AOE 5754 (ME 5554) (ECE 5754):

Applied Linear Systems

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

AOE 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AOE 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

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

AOE 5974:

Independent Study

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

AOE 5984:

Special Study

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

AOE 5994:

Research and Thesis

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

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

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

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

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

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

AOE 6234:

Spacecraft Dynamics and Control

Rigid body kinematics and spacecraft attitude descriptions. Attitude dynamics, motion about the center of mass, gravity gradient, and stability. Methods of attitude control both active (momentum exchange devices, thrusting) and passive (spin stabilization). Small and large angle feedback control laws. Attitude maneuvers of hybrid bodies containing both rigid and flexible components. Pre: AOE 5204, or permission of instructor.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

AOE 6254:

Intelligent Control

Intelligent control design of nonlinear systems, autonomous vehicles, including unmanned aerial vehicles, autonomous underwater vehicles, and spacecraft. Review of methods for stability analysis and robust control. Adaptive control design methodologies. Robustness of adaptive systems. Vision based sensors. Multivariable adaptive control. Output feedback methods.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AOE 6434 (ME 6434):

Computational Fluid Dynamics and Heat Transfer

Overview of numerical methods used in the study of computational fluid dynamics (CFD) and heat transfer. Spatio-temporal finite-difference, finite-volume discretizations, solution of linear systems with direct and iterative methods, algorithms for solving the Navier Stokes and energy equations, and turbulence modeling. Applications to inviscid subsonic, transonic, and supersonic flows and viscous boundary layer. Theory reinforced with hands on programming assignments and the application of commerical CFD packages to select problems.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

AOE 6774 (BMVS 5454) (ME 6574) (VM 8034) (ECE 6774):

Adaptive Control Systems

Introduction to the theory and methodology used to design adaptive controllers for uncertain systems, addressing issue such as input constraints, disturbance rejection, partial measurements, and robustness.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

AOE 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

AOE 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

PHILOSOPHY

James Klagge, Chair

Professors: James Klagge; Deborah Mayo; Joseph Pitt;

Associate Professors: Walter Ott;

Assistant Professors: Simon May; Daniel Parker; Lydia Patton;

Visiting Faculty: Mark Bauer; Lauren Fleming; Matthew King; Marc Lucht; Michael Moehler; Philip Olson; Ted Parent;

Adjunct Professors: James Garrison;

Emeritus Faculty: Henry Bauer; Richard Burian; Harlan Miller; Palmer Talbutt;

Graduate Program Director: ottw@vt.edu

Graduate Coordinator: tzapata@vt.edu

General Contact: leisao@vt.edu

M.A. Program Website: http://www.phil.vt.edu/ma/ma.html

Student Handbook: http://www.phil.vt.edu/ma/GradHandbook.pdf

Placement Record: http://www.phil.vt.edu/ma/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.

DEGREES OFFERED

MA Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (600.0), Quantitative (650.0), Analytical (5.0)

The M.A. degree requires a minimum of 30 credit hours of graduate level work. Students may complete the requirements for the M.A. degree through either the thesis or non-thesis tracks. Students pursuing the thesis track write a thesis and take at least 24 hours of regular coursework. Students pursuing the non-thesis track take at least 27 hours of regular coursework and complete a set of comprehensive exams at the conclusion of the two year program.

GRADUATE COURSES (PHIL)

PHIL 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

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

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

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

PHIL 5304G:

Intermediate Topics in Social and Political Philosophy

Study of topics such as distributive justice, equality, exploitation, alienation, individual rights, anarchy, constitutional government, the justification of political authority, and liberation. Topics to be announced each semester course is offered. May be repeated with different content for a maximum of 6 credit hours. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PHIL 5305 (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

PHIL 5306 (STS 5306):

Main Themes in the Philosophy of Modern Science and Technology

Problems, literature, and schools in the philosophy of science and technology. 5305: explanation and confirmation; 5306: theory change. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

PHIL 5334:

Normative Ethics

A systematic examination of normative ethics, the branch of philosophical ethics that addresses questions about how one should live. Investigation of factors relevant to moral rightness or wrongness, goodness or badness, and the theories that attempt to articulate the complex relations and interactions among them. Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

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

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

PHIL 5974:

Independent Study

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

PHIL 5984:

Special Study

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

PHIL 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

PHIL 6314 (STS 6314) (ME 5754) (BMES 5164) (ME 6754) (BMES 6164):

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

PHYSICS

Beate Schmittmann, Head

Professors: Lay Chang; James Heflin; Pendleton Montague; Seong Mun; Leo Piilonen; Mark Pitt; Ramaswamy Raghavan; Beate Schmittmann; John Simonetti; Uwe Tauber; Robert Vogelaar;

Associate Professors: Nahum Arav; Jean Heremans; Giti Khodaparast; Jonathan Link; Djordje Minic; Kyungwha Park; Michel Pleimling; Victoria Soghomonian; Tatsu Takeuchi;

Assistant Professors: Patrick Huber; Rahul Kulkarni; Hans Robinson; Vito Scarola; Eric Sharpe;

Research Faculty: Kenneth Wong;

Adjunct Professors: Richard Blankenbecler; Charles Bowman; Barry Bressler; Zheng Chang; Victor Gehman; Frank Giovane; Yi-Gao Liang; Zoltan Toroczkai;

Affiliated Faculty: Hassan Aref; Levon Asryan; Stephen Eubank; Louis Guido; Alexey Onufriev; Mark Paul;

Graduate Contact: gradphys@vt.edu

Graduate Program Coordinator: Chris.Thomas@vt.edu

Graduate Site: http://www.phys.vt.edu/students/

Student Handbook: http://www.phys.vt.edu/~piriec/currentGraduateHandbook.pdf

The graduate physics program course work and research lead to the M.S. (thesis optional) and/or to the Ph.D. Research specialization is available in experimental and/or theoretical aspects of astronomical, biophysics, condensed-matter, elementary-particle, mathematical, optical, and statistical physics.The department offers an Applied and Industrial Physics Option which leads to a degree of M.S. in physics and prepares a student to apply broad physics principles to technological problems of interest to industry. The program combines courses with applied and technological relevance with a research project that is carried out either in an industrial laboratory or on campus. Additional emphasis is placed on enhancing the communication skills of the student and on preparing the student to work with a team. The requirements for the degree include a research project leading to a written report and the successful completion of a program of study. Courses in physics, chemistry, materials science engineering, and business may be combined to satisfy the course requirements for the degree. The program can be completed in four semesters.

SPECIAL FACILITIES

Experimental laboratories within the Department of Physics include facilities employing Raman scattering, far-infrared to near-ultraviolet spectroscopy, conventional and superconducting magnets, thin-film electron scattering, susceptometry, sol-gel studies, laser holography and spatial filtering, and pulsed laser nonlinear optical measurements such as harmonic generation and degenerate four-wave mixing, and clean-room. Other techniques and materials are available via collaborative programs with the Departments of Chemistry, Chemical Engineering, and Materials Science. Facilities are maintained in the Department of Physics to prepare experiments and analyze data collected by the radio astronomy and elementary particle groups which are currently working at national and international research centers, including FermiLab (FNAL, Illinois), Brookhaven National Laboratory (BNL, New York), Thomas Jefferson National Accelerator Facility (TJNAF, Virginia), Oak Ridge National Laboratory (ORNL, Tennessee), Laboratori Nazionali del Gran Sasso (LNGS, Italy), Kou Enerugii Kasokukikenkyuukikou (KEK, Japan), Los Alamos National Laboratory (LANL, New Mexico), Kimballton underground science and engineering facility (Virginia), and National Radio Astronomy Observatory (NRAO, including the VLA and VLBA). Housed in the department is the university's Institute for Particle, Nuclear, and Astronomical Sciences (IPNAS). Department of Physics has numerous personal computers and workstations in research laboratories, and a computer room for physics graduate students and majors. The department maintains two computing clusters, a 100 processor computation cluster for graduate students and a 1000+ processor for faculty. Faculty also shares access on the university's System X with 2000+ processors. Access to supercomputers is also available through national and international networks.

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal, Quantitative, Analytical

Degree requirements include courses, both required and elective, thesis research, and examination(s). The credit requirement for a Ph.D. is 90 hours, including a maximum of 60 hours of research and dissertation. For the M.S., there are two options, thesis and non-thesis, both of which require 30 credit hours. In the non-thesis option, at least 24 hours of course work are required, while the thesis option requires at least 20 hours of courses and 6-10 hours of thesis research, respectively.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal, Quantitative, Analytical

Degree requirements include courses, both required and elective, thesis research, and examination(s). The credit requirement for a Ph.D. is 90 hours, including a maximum of 60 hours of research and dissertation. For the M.S., there are two options, thesis and non-thesis, both of which require 30 credit hours. In the non-thesis option, at least 24 hours of course work are required, while the thesis option requires at least 20 hours of courses and 6-10 hours of thesis research, respectively.

GRADUATE COURSES (PHYS)

PHYS 5354:

Classical Mechanics

Theory of classical Lagrangian and Hamiltonian mechanics of particles and rigid bodies, including canonical transformations and Hamilton-Jacobi theory. Consent required. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5405:

Classical Electromagnetism

Classical theory of electromagnetism and its applications. 5405: Electrostatics and magnetostatics; Maxwell's equations and electromagnetic waves; wave guides, apertures, and antennae. 5406: Special relativity and Lagrangian and Hamiltonian formulations; Lienard-Wiechert potentials, motion, radiation, and energy loss be charged particles; self-fields and radiative damping; magnetic monopoles and field theories. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5406:

Classical Electromagnetism

Classical theory of electromagnetism and its applications. 5405: Electrostatics and magnetostatics; Maxwell's equations and electromagnetic waves; wave guides, apertures, and antennae. 5406:

Special relativity and Lagrangian and Hamiltonian formulations; Lienard-Wiechert potentials, motion, radiation, and energy loss be charged particles; self-fields and radiative damping; magnetic monopoles and field theories. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5455:

Quantum Mechanics

General principles of nonrelativistic quantum mechanics from the point of view of advanced dynamics, with applications to problems of atomic and nuclear structure. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5456:

Quantum Mechanics

General principles of nonrelativistic quantum mechanics from the point of view of advanced dynamics, with applications to problems of atomic and nuclear structure. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5504:

Nuclear and Particle Physics

Properties of nuclei, two-nucleon systems, nuclear force, nuclear models, nuclear reactions, alpha and beta decay, and fission. Relativistic kinematics, invariance principles, quantum numbers, strange particles, weak interactions, formation and production reactions, and symmetries. Consent required. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5555:

Solid-State Physics

Solidity, crystal structure, k-space, quantum mechanics of covalent bonding, phonon excitations, thermal energy, the nearly-free-electron approximation, Bloch electrons, E(k) energy bands in semiconductors and metals, density of states, optical properties of solids, donors and acceptors in semiconductors, excitons, plasmons, polaritons, electrical properties, magnetic materials, the percolation model and phase transitions, metal-insulator transitions, and amorphous solids. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5556:

Solid-State Physics

Solidity, crystal structure, k-space, quantum mechanics of covalent bonding, phonon excitations, thermal energy, the nearly-free-electron approximation, Bloch electrons, E(k) energy bands in semiconductors and metals, density of states, optical properties of solids, donors and acceptors in semiconductors, excitons, plasmons, polaritons, electrical properties, magnetic materials, the percolation model and phase transitions, metal-insulator transitions, and amorphous solids. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5574G:

Intermediate Nanotechnology

Methods of controlling matter on the nanometer length scale and the applications thereof. Nanolithography, self-assembly, and scanned probe microscopy; nanomaterials including fullerenes, carbon nanotubes, and quantum dots; nanoscale and molecular electronics; nanoelectromechanical systems; nanoscale optoelectronics; and nanobiotechnology. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PHYS 5614:

Introduction to Quantum Electronics

Theory of laser oscillation, optical resonators, interaction of radiation and atomic systems, giant pulsed lasers, laser systems, wave propagation in nonlinear media, modulation of optical radiation, noise in optical detection and generation, and interaction of light and sound. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5614G:

Intermediate Optics

Fundamentals of the ray, wave and quantum models of light, and topics in modern optics with contemporary applications. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PHYS 5674G:

Intermediate General Relativity

Methods and applications of Einstein's general theory of relativity. Space and time and gravity in Newtonian physics; special theory of relativity; gravity as geometry of curved spacetime; black holes; cosmology; Einstein's gravitational field equations; gravitational waves and relativistic stars. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PHYS 5705:

Statistical Mechanics

Theory of classical and quantum statistical mechanics. Derivation of thermodynamics. 5705: ensembles, fluctuations and ideal gas systems. 5706: modern developments and advanced topics. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5706:

Statistical Mechanics

Theory of classical and quantum statistical mechanics. Derivation of thermodynamics. 5705: ensembles, fluctuations and ideal gas systems. 5706: modern developments and advanced topics. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5714:

Methods of Theoretical Physics

Selected topics in mathematical physics. Review of analytic function theory. Matrices, spectral theory of operators in Hilbert Space with applications to quantum mechanics. Solution of partial differential equations of mathematical physics, boundary-value problems, and special functions. Distribution theory and Green's functions. Consent required. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5714G:

Biophysics

Selected topics from the general area of biomechanics, bioelectricity, radiation biophysics, molecular biophysics, and thermodynamics and transport in biological systems. Emphasis on the physical aspects of biological phenomena and biophysical measurement techniques and instrumentation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PHYS 5794:

Computational Physics

Survey of computational methods in physics. Applications of Fourier analysis, curve fitting, solving differential equations, solving integral equations, Monte Carlo simulations, symbolic mathematics, and graphic simulations in mechanics, electromagnetism, nuclear physics, atomic physics, molecular physics, and condensed matter physics. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

PHYS 5944:

Seminar

May be repeated one time with different content for a maximum of 2 credits.

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

PHYS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

PHYS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

PHYS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

PHYS 6455:

Advanced Quantum Theory

Classical field theory; Noether's theorem and symmetries; second quantization and many-body formalism; free quantum Klein-Gordon, Dirac, and Maxwell fields; and interacting fields, S-matrix and covariant perturbation theory. Feynman diagrams; quantum electrodynamics; renormalization; path-integral formulation; non-Abelian gauge theories; and elements of electro-weak theory. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6456:

Advanced Quantum Theory

Classical field theory; Noether's theorem and symmetries; second quantization and many-body formalism; free quantum Klein-Gordon, Dirac, and Maxwell fields; and interacting fields, S-matrix and covariant perturbation theory. Feynman diagrams; quantum electrodynamics; renormalization; path-integral formulation; non-Abelian guage theories; and elements of electro-weak theory. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6555:

Advanced Solid-State Physics

Applications of field-theory techniques to many-body aspects of solid-state physics. 6555: Green functions, Feynman diagrams, lattice Hamiltonian, neutron scattering, electron gas, Fermi-liquid theory, and linear-response theory. 6556: Electron-phonon interaction in metals and semiconductors, polarons, optical properties, excitons, superconductivity, and excitations in magnetic materials. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6556:

Advanced Solid-State Physics

Applications of field-theory techniques to many-body aspects of solid-state physics. 6555: Green functions, Feynman diagrams, lattice Hamiltonian, neutron scattering, electron gas, Fermi-liquid theory, and linear-response theory. 6556: Electron-phonon interaction in metals and semiconductors, polarons, optical properties, excitons, superconductivity, and excitations in magnetic materials. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6675:

General Relativity and Cosmology

6675: Differential geometry; equivalence principle; general theory of relativity; classical tests; post-Newtonian approximation; special solutions. 6676: Black holes; observational basis of cosmology; relativistic model universes; nucleosynthesis; cosmic background radiation; dark matter; inflation. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6676:

General Relativity and Cosmology

6675: Differential geometry; equivalence principle; general theory of relativity; classical tests; post-Newtonian approximation; special solutions. 6676: Black holes; observational basis of cosmology; relativistic model universes; nucleosynthesis; cosmoic background radiation; dark matter; inflation. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6714:

Selected Topics in Theoretical Physics

Topics of current interest in theoretical physics as announced in Timetable. May be repeated for credit with permission. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6725:

Elementary Particle Physics

Symmetry principles, quark model, scattering-theory and particle-theory processes, weak interactions, quantum chromodynamics, spontaneous symmetry breaking, and unified field theories. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6726:

Elementary Particle Physics

Symmetry principles, quark model, scattering-theory and particle-theory processes, weak interactions, quantum chromodynamics, spontaneous symmetry breaking, and unified field theories. Consent required. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6755:

Mathematical Foundations of Quantum Mechanics

Advanced course in mathematical physics which encompasses the frontiers of research in quantum theory. Content varies from year to year and includes scattering theory, spectral and perturbation theory, and many-body quantum dynamics. This course frequently taken concurrent with thesis research. The course alternates with Math 6745-6746 and may be taken a second time with instructor's consent. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 6756:

Mathematical Foundations of Quantum Mechanics

Advanced course in mathematical physics which encompasses the frontiers of research in quantum theory. Content varies from year to year and includes scattering theory, spectral and perturbation theory, and many-body quantum dynamics. This course frequently taken concurrent with thesis research. The course alternates with Math 6745-6746 and may be taken a second time with instructor's consent. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PHYS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

PLANNING, GOVERNANCE, AND GLOBALIZATION

Anne Khademian, Head

Professors: James Bohland; John Browder; Brian Cook; Wilma Dunaway; Gerard Kearns; Anne Khademian; Paul Knox; Charles Koebel; Ilja Luciak; Timothy Luke; Patrick Miller; John Randolph; Richard Rich; Joyce Rothschild; Thomas Sanchez; Gerard Toal; Edward Weisband;

Associate Professors: Dean Bork; Sang Choi; Casey Dawkins; Sonia Hirt; Wendy Jacobson; Laura Jensen; Mintai Kim; Heike Mayer; Joel Peters; Joseph Rees; Jesse Richardson; Max Stephenson; Karen Till; Kris Wernstedt; Diane Zahm;

Assistant Professors: Ralph Buehler; Margaret Cowell; Giselle Datz; Matthew Dull; Ralph Hall; Derek Hyra; Patrick Roberts; Rupa Thadhani; Yang Zhang;

Emeritus Faculty: Larkin Dudley; Benjamin Johnson;

University Distinguished Professor: Paul Knox; Timothy Luke;

Edward S. Diggs: Edward Weisband;

School of Public & International Affairs: spia@vt.edu

Planning, Governance, & Globalization:

http://www.spia.vt.edu/programs/grad_info/phdprogs/phdpgg.html

Student Handbook:

http://www.spia.vt.edu/SPIA/admindocs/pgghandbooks/pgghandbook.pdf

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 & PlanningThematic Areas:Metropolitan Development; Community & Economic Development Planning; International Development Planning; Landscape/Environmental Planning & Landscape Analysis; Transportation Planning; Physical Planning & Urban DesignGovernance & GlobalizationThematic 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, this space has 18 individual desks, two couches, a kitchen area, and a space with four public computers. So far, students use the studio area in different ways: some spend most of their working time at their desks inthe 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 faculty direct two University-wide centers and institutes (VCHR and IPG), one College institute (MI), and one SPIA institute (ICH).The Institute for Community Health (ICH) aids in identifying communities that have established programs and efforts to positively impact health related problems. ICH conducts research and assistance projects related to public health, health service delivery, and health impacts of development. 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 (National Capital Region, Blacksburg)

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 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 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.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: EDP 6006 Theory: 1 course, 3 credits. Satisfied by completion of EDP 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): EDP/GIA/UAP 7994 Research and Dissertation.In addition, the Governance & Globalization track requires proficiency in a foreign language. 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): EDP 6006 EDP 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 â?? 3 credits) and UAP 5494 (Advanced Quantitative Techniques - 3 credits), or equivalents. Research (30 credits): EDP/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 5704 - Advanced Landscape Design and Planning Lab (5 credits); LAR 5724 - Scholarship in Landscape Architecture (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 proposalbefore his or her faculty advisory committee. Upon completion of the dissertation, the student must defend it before the committee. Graduate School policies and guidelines determine all other degree requirements.

PLANT PATHOLOGY, PHYSIOLOGY, AND WEED SCIENCE

Elizabeth Grabau, Head

Professors: Jeffrey Derr; Jonathan Eisenback; Elizabeth Grabau; Ruth Grene; Edward Hagood; Chuanxue Hong; Charles Johnson; Patrick Phipps; Erik Stromberg; Sue Tolin; Henry Wilson; Keith Yoder;

Associate Professors: Shawn Askew; Antonius Baudoin; John Jelesko; John McDowell; Boris Vinatzer; James Westwood;

Assistant Professors: Maria Balota; Eva Colla'kova'; Sakiko Okumoto; Guillaume Pilot; Steven Rideout; David Schmale;

Research Faculty: Cynthia Denbow; Perry Hipkins; Mizuho Nita;

Instructors: Mary Hansen;

General Contact: wlwnd@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 the flexibility among the different options. Finally, the Department participates actively in several interdepartmental programs such as the Interdepartmental Plant Physiology Program, 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 in 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

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 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 graduate 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

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

PPWS 5044 (APSC 5044):

Biotechnology in Agriculture and Society

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

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. Techniques for experimental plant pathology. Graduate standing required.

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

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

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

PPWS 5304 (BMES 5304) (CHE 5304) (BIOL 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): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

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

PPWS 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. I

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

PPWS 5344 (CS 5474) (MATH 5474) (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

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

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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PPWS 5534 (HORT 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. I,II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

PPWS 5754:

Herbicide Action and Metabolism

The study of the properties and characteristics of herbicides, the fundamental processes and principles involved in their action, and their metabolic detoxification by higher plants and microorganisms. Principles of herbicide selectivity and modern approaches to increase it. II

Credit Hour(s): 0 OR 3

Lecture Hour(s): 0 OR 2

Instruction Type(s): Lab, Lecture

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

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

PPWS 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

PPWS 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

PPWS 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

PPWS 6024:

Topics in Molecular Cell Biology and Biotechnology

Specific areas such as the molecular biology of plant and animal disease resistance, of photosynthesis, of oncogenes, of organelle assembly, and of growth and development, structure and function of polyamines and of proteases will be discussed. Students will give presentations and critically analyze current literature. May be repeated. I,II

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

PPWS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

POLITICAL SCIENCE

Timothy Luke, Chair

Professors: Karen Hult; Ilja Luciak; Timothy Luke; Richard Rich; Charles Taylor; Charles Walcott; Edward Weisband;

Associate Professors: Craig Brians; Deborah Milly; Wayne Moore; Scott Nelson; Richard Shingles; Ioannis Stivachtis; Laura Zanotti;

Assistant Professors: Parakh Hoon; Bettina Koch; Chad Lavin;

Affiliated Faculty: Burton Atkins; Laura Jensen; James Monroe; Joel Peters; R Eric Petersen; Georgeta Pourchot; Gerard Toal;

University Distinguished: Timothy Luke;

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

General Contact: pscigrad@vt.edu

Student Handbook: http://www.psci.vt.edu/main/graduate/GradBroc.pdf

The Master of Arts in Political Science was established in 1969. Currently the program enrolls 15 to 20 full-time students on campus each year, and approximately 40-50 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 M.A. programs of study. The Master of Arts Program covers all sub-fields of the discipline, and it prepares students for careers in academic life and government service. 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 a career in a public or private research organization. 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 our M.A. program from a number of other nations including Argentina, Austria, Bolivia, Brazil, Canada, China, England, France, Germany, Greece, India, Ireland, Israel, Mexico, Norway, Portugal, Romania, Scotland, Sweden, and Switzerland, and Turkey lending an international flavor to the educational environment. Recent graduates of our M.A. program 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 State, Georgia, Indiana, Iowa, Johns Hopkins University, Kentucky, London School of Economics, Massachusetts-Amherst, Maryland, Miami, Minnesota, Michigan State, Nebraska, North Carolina, Penn State, Pittsburgh, Purdue, Ohio State, Oregon, Oxford, Strathclyde, SUNY-Albany, SUNY-Stony Brook, Syracuse, Texas-Austin, Washington University-St. Louis, Utah, Wisconsin and Virginia Tech, and Virginia. Other graduates have taken professional positions in government agencies, political organizations, and research institutes.

SPECIAL FACILITIES

The Political Science Research Lab is open to graduate students 24 hours a day. It contains several microcomputers linked to the Internet, state-wide, and campus networks. A variety of research and word processing software is available for these machines. Knowledge of these resources combined with our emphasis on quantitative methods is a valuable asset 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).

Computer Facilities

The Political Science Research Lab is open to graduate students 24 hours a day. It contains several microcomputers linked to the Internet, state-wide, and campus networks.Â A variety of research and word processing software is available for these machines. Knowledge of these resources combined with our emphasis on quantitative methods is a valuable asset 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)

Computer: (250.0)

iBT: (100.0)

GRE (1150)

The degree requirements for the MA are 21 hours of coursework. Three classes are required, PSCI 5115, 5116, and 5124 (total of 9 cr.) and 4 electives (12 cr.). Also, 9 hours of Thesis and Research.

GRADUATE COURSES (PSCI)

PSCI 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

PSCI 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

PSCI 5124:

Advanced Research Issues

Advanced work in research methods including the conceptual issues underlying measurement and data analysis. Covers appropriate techniques for addressing those issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PSCI 5164 (UAP 5164) (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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

PSCI 5224 (GIA 5224):

Alternative Perspectives in Political Theory

Analysis of selected perspectives on politics including: rational choice theory, critical theory, neo-marxism, neo-conservatism, post-industrialism, and post-structuralism.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PSCI 5244:

Constitutionalism in Theory and Practice

The course investigates theories and practices of constitutionalism, both within the United Sttes and more generally. It frames a number of questions about what characterizes constitutionalism as a distinctive theory of politics, while also examining the construction, maintenance, change, and destruction in practice of constitutional orders, constitutions, constitutional institutions, and other constitutional norms. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PSCI 5254 (UAP 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

PSCI 5264:
Globl Change & Local Impacts
All jurisdictions, national, regional, or local, function in an interconnected global market. Understanding the structure and interactions within the global market and the impacts therein is the focus of PSCI 5264. Thematic topics include a review of welfare state functions, privatization, decentralization, and nonprofit organizations and their relation to global market dynamics. Upon completion of the courses, students will have and understanding of how global forces influence local areas and how local leaders have developed strategies to cope with their position in an increasingly global market.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

PSCI 5284 (UAP 5274) (GIA 5274) (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

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

PSCI 5324:
The 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

PSCI 5334:
The 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

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

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

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

PSCI 5374:

Electronic Governance

Examines applications of information technology in government from the point of view of governments and citizens. Survey of the relationship between e-government 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

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

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

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

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

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

PSCI 5464 (ASPT 5464):

Critical Security Studies

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

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

PSCI 5484 (ESM 5464) (CEE 5464) (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

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

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

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

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

PSCI 5554 (ECE 5504) (GIA 5554) (CS 5504):
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

PSCI 5564 (GIA 5564) (CHEM 5094) (FST 5094) (WS 5564) (BMVS 5094):
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

PSCI 5574 (GIA 5574) (UAP 5574):
Arts, Culture and Society
Considers the role of the arts in society, including architecture, music companies, or theater productions to heritage sites, science museums, and art galleries. Effective arts policy in revitalizing urban economies also examined. Graduate standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

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

PSCI 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PSCI 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study, VI

PSCI 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

PSCI 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

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

PSCI 6124:

Topics in Security Studies

Surveys the interface of globalization and security and the changing paradigm of security within golbal 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

PSCI 6134 (GIA 6134):

Topics in Conflict Analysis

Provides a comprehensive guide to the understanding of comtemporary 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.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PSCI 6144 (GIA 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

PSCI 6204 (GIA 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

PSCI 6214 (BSE 5044) (BMES 5044) (GIA 6214) (CHE 5044):

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

PSCI 6224 (CHE 5214) (GIA 6224) (BMES 5434):

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

PSCI 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

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

PSCI 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

PSCI 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

PSYCHOLOGY

Robert Stephens, Head

Professors: Martha Ann Bell; George Clum; Kirby Deater-Deckard; Jack Finney; E Geller; Russell Jones; Thomas Ollendick; Robert Stephens; Richard Winett;

Associate Professors: Danny Axsom; Lee Cooper; Julie Dunsmore; Roseanne Foti; Joseph Germana; David Harrison; Robert Harvey; Neil Hauenstein; Robin Panneton; Angela Scarpa-Friedman; Bruce Scarpa-Friedman;

Assistant Professors: Bethany Bray; Matthew Fritz; Jungmeen Kim-Spoon; Susan White;

Research Faculty: Eileen Anderson; Bradley White;

Alumni Distinguished Professor: E Geller;

University Distinguished Professor: Thomas Ollendick;

Heilig Meyers Professor: Richard Winett;

Graduate Contact: kirbydd@vt.edu

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

Student Handbook:

http://filebox.vt.edu/users/kirbydd/Handbook%20of%20Rules%20and%20Regulations%202010-2011%20Feb%2010%202010.pdf

The Department of Psychology at Virginia Tech offers graduate programs leading to the Ph.D. in three areas: Clinical Psychology, Industrial/Organizational Psychology, and Developmental and Biological 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 three 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

DEGREES OFFERED

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

MS: University minimums for research/thesis and non-thesis credit hours, plus additional specified courses and completion of Thesis as described in student handbook.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

PhD: University minimums for research/dissertation and non-dissertation credit hours plus additional specified courses and completion of Preliminary Examination and Dissertation as described in student handbook.

GRADUATE COURSES (PSYC)

PSYC 5114:

Survey of Industrial Psychology

Survey of major topics in Industrial Psychology. Emphasis is placed on theories and empirical research in the areas of psychological testing, prediction of job performance, criterion development, performance appraisal, performance management, decision theory in personnel selection, utility analysis, affirmative action, legal issues in human resource management, diversity programs, job analysis, and training and development.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PSYC 5124:

Survey of Organizational Psychology

Provides a survey of topics relevant to the field of Organizational Psychology, Micro-level topics include motivation, attitudes, organizational entry, commitment and withdrawal. Macro-level topics include leadership, leadership-member theories, organizational development and systems theory. The course will emphasize theoretical and research issues.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PSYC 5134:

Advanced Psychometric Theory

Course focuses on the development and evaluation of psychological measures. Topics covered will focus on test development, classical test theory, and item-response theory.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PSYC 5274:

Personality Processes

Theory, research, and application in contemporary personality psychology.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

PSYC 5534:

Developmental Psychology

Examines the processes underlying cognitive and social development through the life span. In addition to the critical examination of theories exploring changes in cognition and social behavior, the relative role of phylogeny and ontogeny are explored and evaluated.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

PSYC 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

PSYC 5984:
Special Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Lecture

PSYC 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

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

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

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

PSYC 6404:
Behavior Management in Large-scale Systems
Theoretical and empirical overview of the management of human behavior in community, institutional, and organizational environments. Methodologies for evaluation and refining specific intervention procedures.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

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

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 3

Lecture Hour(s): 1 TO 16

Instruction Type(s): Lecture

PSYC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

PSYC 7965:

Internship

During the third or fourth year the clinical student shall be involved in a full-time supervised internship program in a clinical setting approved by his advisory committee and the director of clinical psychology training program. The minimum duration shall be 11 months.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PSYC 7966:

Internship

During the third or fourth year the clinical student shall be involved in a full-time supervised internship program in a clinical setting approved by his advisory committee and the director of clinical psychology training program. The minimum duration shall be 11 months.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PSYC 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Research

PUBLIC ADMINISTRATION AND PUBLIC AFFAIRS

Brian Cook, Head

Professors: Brian Cook; Bruce Lawlor; Robert Stephan; Charles Stripling; James Wolf;

Associate Professors: Larkin Dudley; Laura Jensen; Anne Khademian; Joseph Rees;

Assistant Professors: Sang Choi; Matthew Dull; Patrick Roberts;

Research Faculty: John Harrald; Theresa Jefferson;

Visiting Faculty: Colleen Woodard;

Adjunct Professors: Ronald Boster; Suzette Denslow; Jason Fichtner; David Hallock; Thomas Hickok; Randall Murch; William Murray; Mark Robertson; Mark Rosen;

Affiliated Faculty: Karen Hult;

Emeritus Faculty: John Dickey; Charles Goodsell; Philip Kronenberg; John Rohr; Gary Wamsley; Orion White;

General Contact: cpap@vt.edu

Graduate Contact: cpap@vt.edu

Center for Public Administration and Policy: http://www.cpap.vt.edu/

The Center for Public Administration and Policy (CPAP) promotes the common good of our constitutional republic and the advancement of public service by providing outstanding education, research, and outreach in the theory and practice of public administration, management, and policy. Our goals are to: provide qualified public administrators currently in service, and early-career students who intend to become public administrators, with challenging applied and theoretical professional development opportunities in public management and public policy. prepare teachers and scholars for faculty service in colleges and universities around the country and the world who will educate citizens and administrators and broaden the scope of knowledge in public administration and policy studies. engage faculty, practitioners, and graduate students in systematic research and study designed to improve the quality of policy making and public service within the diverse jurisdictions of government in the Commonwealth of Virginia and the region, and on the Federal, state, and local levels of government in the United States and internationally.The Master of Public Administration (MPA) is a professional degree intended for future and present practitioners. Its purpose is to educate early career individuals for administrative and analytical posts and to improve the skills of in-career public administrators. Most of the students seeking the degree at our National Capital Region (Old Town Alexandria) and Capital Region (Richmond Center) sites are in-career students. The Blacksburg campus tends to enroll more pre- and early career students and offers a specially designed cohort program with opportunities for internship placement support and career development guidance. International students should note that a substantial portion of the M.P.A. Program's subject matter focuses primarily upon public administration, management, and policy in the United States.The Doctor of Philosophy (Ph.D.) is the academy's highest degree and prepares students for research and scholarship, whether or not in affiliation with a university. CPAP offers the Ph.D. in Public Administration and Public Affairs to both full-time and part-time students. Many of our students are mid-career professionals who have reached a point in their career development at which they can commit the time and energy necessary to earn a doctorate. Qualified individuals just beginning their careers are also most welcome. A master's degree in a relevant field (not necessarily public administration or public policy) ordinarily is required for admission, but this requirement may be waived in exceptional cases. Those earning the M.P.A. from CPAP may apply for admission to the Ph.D. program as the end of their work toward the M.P.A. draws near.

SPECIAL FACILITIES

Beyond the main campus, CPAP offers students opportunities to earn the M.P.A. and/or the Ph.D. in the rich learning environments of Old Town Alexandria, VA (adjacent to Washington, DC) and Richmond, VA, the state capital.

DEGREES OFFERED

PhD Degree

Offered In (National Capital Region, Blacksburg, Richmond)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

GRE

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 of DMP credit.We require all PhD applicants to submit scores from one of the following graduate admissions tests: GRE, GMAT,LSAT, or MAT.

MPA Degree

Offered In (National Capital Region, Blacksburg)

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, for a total of 36 credit hours. The M.P.A. requires either 39 or 42 credit hours, depending upon whether students complete an internship or professional paper (39 credits for the M.P.A.) or thesis (42 credits for the M.P.A. with Thesis). Entering MPA students must have taken at least one undergraduate course on the institutions of American 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.While we requires PhD applicants to submit scores from one of the following graduate admissions tests: GRE, GMAT, LSAT, or MAT.Test scores for MPA applicants are apotional.

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

PAPA 5034 (STS 5206) (HIST 5206) (GIA 5034) (UAP 5034):

Democratic Governance in the Economy

An international and comparative examination of workplace and economic relations around the world, with special focus on efforts to build collaborative work processes that would extend the voice, ownership and control rights of workers. The interface between state institutions and economic organizations is also considered, especially insofar as government prescriptions and processes that may impede or extend democratic governance of the economy. Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

PAPA 5214 (SOC 5214) (CS 5566) (ECE 5566):

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

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

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

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

PAPA 5354:

HMLND 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

PAPA 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 Graduate standing. approaches to disciplined analysis, including ethical issues in research. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

PAPA 5544 (UAP 5544):

Public and Non-profit Financial Management

Examines concepts central to effective financial management of public and non-profit organizations. Affords students an opportunity to further their understanding of the relationship between financial accounting and reporting systems and effective organization management. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

PAPA 5674:

Financial Health of Public and Nonprofit Organizations

Concepts and analytical capacities necessary to evaluate the overall level of financial health of governmental and nonprofit/nongovernmental organizations. Examines the tools and techniques necessary to assess the financial condition of the organizations and to determine if they have the capacity to carry out their purposes and address their debt obligations. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

PAPA 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research, Online Research

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

PAPA 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

PAPA 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

PAPA 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

PAPA 6024:

The Context of Public Administration

Examines the history of public administration as a field of study; the politico-economic context of public administration as an element of governance; and international comparisons of public administrative behavior.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

PAPA 6124:

Behavior and Change in Public Organizations

Dynamics of behavior and change process in public sector organizations are examined for: (1) their implications for individuals, groups, and society; and (2) their impact upon organizational productivity and public policy. Critical dimensions of leadership as a sociopsychological process in management are emphasized with special reference to the public sector and public executives. The course also surveys the various types and strategies for planned change in public sector organizations.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

PAPA 6194:

Capstone Seminar in Public Organizations

Advanced doctoral seminar involving original conceptualization and research into specific aspects of collective behavior, leadership, and change processes of complex, formal, public organizations. Foci for analysis include dynamics within, and linkages among small groups, organizations, and interorganizational networks.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

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

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

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

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

PAPA 6494:

Capstone Seminar in Ethics and the Public Sector

Original research into specific aspects of professional ethics in the public sector. Emphasis on particular problems for career personnel.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

PAPA 6984:

Special Study

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

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

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

PAPA 7994:

Research and Dissertation

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

PUBLIC HEALTH

Francois Elvinger, Interim Head

Professors: Francois Elvinger; Kerry Redican;

Associate Professors: Kathryn Hosig; Susan Marmagas;

Graduate Contact: cris75@vt.edu

Graduate Site: www.mph.vetmed.vt.edu

Virginia Tech, in collaboration with the Virginia Tech Carilion School of Medicine (VTCSOM), offers a collaborative, Public Health Program in the Department of Population Health Sciences. It is designed to provide students the requisite advanced skills and expertise necessary to join the public health workforce with a Master of Public Health degree. The integration and expansion of public health offerings at Virginia Tech and VTCSOM will contribute to the improvement of health in communities of Southwest Virginia, the Commonwealth, the Appalachian Region, the United States, and beyond. Housed in the Virginia-Maryland Regional College of Veterinary Medicine, the Master of Public Health degree provides professional preparation in the core competencies, functions, and responsibilities of public health, with the goal of placing graduates into public health positions following completion of the program. The program offers flexible plans of study to address the needs of students pursuing complementary degrees and those who are already in the workforce as practicing professionals. Program faculty and students conduct public health research in partnership with health agencies throughout the region. Research efforts are directed at personal, social and ecological determinants of health, reducing social inequalities in health, and building healthy communities. Goals of the program are the development of mutually beneficial partnerships with communities, local health departments, community based organizations, community college partners, government, and other institutions.

SPECIAL FACILITIES

DEGREES OFFERED

MPH Degree

Offered In (Blacksburg)

GRE

General: Verbal, Quantitative

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. Required core courses: PHS 5004: Fundamentals of Public Health STAT 5674: Methods in Biostatistics PHS 5014: Environmental Health PHS 5024 / HNFE 2724: Epidemiology PHS 5034: Health Behavior and Health Education PHS 5044: Public Health Administration PHS 5914: Practicum in Public Health PHS 5924: Capstone in Public Health Admission Requirements: For admission consideration in Summer I or Fall, applications must be received by the Graduate School by January 15th of the year you wish to enroll. Supporting materials (transcripts, test scores, etc.) must be received by no later than January 31. Applicants must submit the following: Resume (with application) 500-700 word Statement of Purpose (with application) 2 copies of transcripts (1 copy to Graduate School and 1 copy to department coordinator) 3 letters of recommendation to department coordinator Current GRE test scores (no minimum score) For more information on admission requirements or information sessions, please visit the Master of Public Health website.

Degree Concentrations:

Public Health Education

Courses in the Public Health Education concentration include principles in health education, program planning and evaluation, and health disparities. PHS 5204: Principles of Community Health Education PHS 5214: Program Development in Health Education HD 5644: Program Planning and Evaluation in Human Development AFST 5354: Topics in Health Disparities

Infectious Disease

Courses in the Infectious Degree track include zoonoses, infectious disease epidemiology, and infection control and prevention. BIOL 5664G: Advanced Virology PHS 5304: Zoonoses and Infectious Diseases Common to Humans and Animals PHS 5314: Infectious Disease Epidemiology PHS 5324: Public Health Infection Control and Prevention *Course under development. To be offered Fall 2011

Electives

PHS 5224: Comparative Health Systems PHS 5704: Educational Technology in Public Health PHS 5714: Health of the Elderly

GRADUATE COURSES (PHS)

PHS 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

PHS 5014:

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

PHS 5024 (FST 5384) (HNFE 5724) (CHEM 5384) (BMVS 5384):
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

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

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

PHS 5204:
Prin Community Health Ed
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

PHS 5214 (HNFE 5684):
Program Development in Health Education
Theory, trends, and design of community health education programs implemented in communities, health agencies, hospitals, and industry.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

PHS 5304:
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

PHS 5314:
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

PHS 5704:
Educat Technol Public Health
Role of technological concepts in the development, implementation, and evaluation of public health and health promotion programs; emphasis on sound principles of educational design, digital media application, development of podcats, development of web pages, and technology use in e-learning and all facets of public education and promotion. Pre-requisite: Graduate Standing required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

PHS 5914:

Practicum in Public Health

Public health theories and concepts in a work setting; comprehensive, strucrures 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

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

RHETORIC AND WRITING

Joseph Eska, Chair

Professors: Diana George; Bernice Hausman; David Radcliffe; Carolyn Rude;

Associate Professors: Kelly Belanger; Eva Brumberger; Sheila Carter-Tod; James Collier; Clare Dannenberg; Shelli Fowler; Paul Heilker; Katrina Powell;

Assistant Professors: Carlos Evia; Kelly Pender;

Research Faculty: James Dubinsky;

Visiting Faculty: Elizabeth Mazzolini;

Graduate Contact: Paul.Heilker@vt.edu

Graduate Contact: sallyw@vt.edu

Graduate Site: http://www.english.vt.edu/graduate/PhD/

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 rhetorical 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 diversity and difference the environment scholarly inquiry medicine and disability education civic engagement globalized communication and commerce

SPECIAL FACILITIES

Center for the Study of Rhetoric in Society http://www.rhetoric.english.vt.edu/index.htmlOur mission: To study the role of language in individual and social transformation.Our vision: To advance the study of rhetoric and writing through projects and partnerships that promote the public good.Our central research question: How do texts (digital, print, multimedia, visual, and verbal) mediate knowledge and action in a variety of social and professional contexts

Center for the Study of Rhetoric in Society

Our mission is to study the role of language in individual and social transformation. Our vision is to advance the study of rhetoric and writing through projects and partnerships that promote the public good. Our central research question is how do texts (digital, print, multimedia, visual, and verbal) mediate knowledge and action in a variety of social and professional contexts.

DEGREES OFFERED

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: 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, and Engineering Education, as well as courses in preparing the future professoriate offered by the Virginia Tech Graduate School.http://www.english.vt.edu/graduate/PhD/require.html

SCIENCE AND TECHNOLOGY STUDIES

Ellsworth Fuhrman, Head

Professors: Gary Downey; Doris Zallen;

Associate Professors: Barbara Allen; Daniel Breslau; Saul Halfon; Ann Laberge; Eileen Patzig;

Assistant Professors: Janet Abbate; Sonja Schmid; Matthew Wisnioski;

General Contact: crcrigge@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.

DEGREES OFFERED

MS Degree

Offered In (National Capital Region, Blacksburg)

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: http://www.sts.vt.edu/mscourses.php PhD course requirements can be found on this website: http://www.sts.vt.edu/masters.php

PhD Degree

Offered In (National Capital Region, Blacksburg)

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: http://www.sts.vt.edu/mscourses.php PhD course requirements can be found on this website: http://www.sts.vt.edu/masters.php

GRADUATE COURSES (STS)

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

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

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

STS 5206 (HIST 5206) (GIA 5034) (UAP 5034) (PAPA 5034):

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

STS 5305 (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

STS 5306 (PHIL 5306):
Main Themes in the Philosophy of Modern Science and Technology
Problems, literature, and schools in the philosophy of science and technology. 5305: explanation and confirmation; 5306: theory change. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

STS 5404:
Development of Modern American Science
Development of the sciences and the community of scientists in the American national context. Emphasis on scientific, institutional, and social events from 1830s through 1980s, including the circumstances surrounding the creation of nuclear weapons and the emergence of "big science." An interdisciplinary perspective, exploring traditional and contemporary historiographical and methodological issues and approaches. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

STS 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

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

STS 5974:
Independent Study
Credit Hour(s): 1 TO 19
Lecture Hour(s): 1 TO 19
Instruction Type(s): Independent Study

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

STS 5994:
Research and Thesis
Credit Hour(s): 1 TO 19
Lecture Hour(s):
Instruction Type(s): Research

STS 6224:
Science, Technology and the Enlightenment
Science, technology, and medicine and their social and cultural interrelationships in the eighteenth and early nineteenth centuries. The modern agenda; nature, knowledge, and progress. Early social science.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

STS 6314 (PHIL 6314) (ME 5754) (BMES 5164) (ME 6754) (BMES 6164):
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. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

STS 6534:
Cultural Studies of Science, Technology, and Medicine
Examines the articulation of science, technology, and medicine in diverse cultural contexts. Focuses on exchange of metaphors and forms of discourse with other cultural activities. Includes knowledge forms in popular domains, cultural performances, fashioning of selves, power relations across boundaries, cross-cultural comparisons, and cultural critiques.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

STS 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

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

STS 6624:

Advanced Topics in the Life Sciences and Medicine

Variable topics in the life sciences and medicine, such as the reception of Darwinism, conceptual foundations of biology, history of genetics, scientific and technological medicine, public health and epidemiology. May be repeated with a different topic for a amximum of 6 credits.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

STS 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

STS 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

SOCIOLOGY

John Ryan, Chair

Professors: Onwubiko Agozino; Toni Calasanti; Theodore Fuller; James Hawdon; Michael Hughes; Wornie Reed; John Ryan; Donald Shoemaker; Barbara Smith;

Associate Professors: Carol Bailey; Carol Burger; Samuel Cook; Laura Gillman; Anthony Harrison; K Kiecolt; Neal King; Anastasia Vogt Yuan; Dale Wimberley;

Assistant Professors: Rachelle Brunn; Ellington Graves; Lakshmi Jayaram; Minjeong Kim; Paulo Polanah; Paula Seniors; Haiyan Zhu;

Emeritus Faculty: John Ballweg; Alan Bayer; Clifton Bryant; Bradley Hertel; William Snizek;

General Contact: nmking@vt.edu

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 12 affiliated faculty. Additional sociologists are faculty members in other departments and programs in the University. The department is also home to the Africana Studies Program and the Women's and Gender Studies Program. Our faculty earned degrees from some of the finest doctoral programs in their fields. They have authored or edited 50 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 600 professional articles and chapters, written over 180 technical reports related to applied sociological issues, and participated in more than 75 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 issues of quality of life, inequality, and work and technology, students have the opportunity to specialize in such areas as health, crime/deviance, gender, race, aging, social organization, and culture. In addition, students may choose a specialization in 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 have the opportunity to establish their own programs of study, to engage in their own independent research, to present papers at professional meetings, and to publish. Doctoral students also have the opportunity to gain independent classroom teaching experience.

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 (500.0), Quantitative (550.0), Analytical (5.0)

The Master's Degree has five options: Master's Degree Thesis Option, Master's Degree Non-thesis Option, Master's Degree Thesis Option with Africana Studies, Master's Degree Non-Thesis Option with Africana Studies, and a Master's Degree Thesis Option with Women's and Gender Studies. Master's students choosing the thesis option 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. Master's students choosing the non-thesis option must complete 30 hours of coursework and pass an examination. The examination will assess the student's general knowledge of sociological concepts, theories, and methodological practices.

PhD Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal (500.0), Quantitative (550.0), 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

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

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

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

SOC 5214 (PAPA 5214) (CS 5566) (ECE 5566):
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

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

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

SOC 5444:
Workplace Deviance and Crime
Examination of deviant and criminal behavior in work settings. Stresses and problems in the work system that induce or facilitate deviance and crime. Dimensions of work structure and culture that are conducive to deviance and crime, and the opportunity structures that work systems provide. Emphasis on the theoretical analysis of workplace deviance.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

SOC 5504:
Population Processes and Policies
Historical and comparative studies of population processes (fertility, mortality, migration); contemporary issues related to consequences of population change; population policies designed to modify population trends. Graduate standing required.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

SOC 5524:
International 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

SOC 5604:

Organizations in Society

Review of major theories and dimensions of modern organizations, especially technological and managerial arenas influenced by class and power. Labor processes internal to organizations and power networks among organizations. Includes cross-national comparisons.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

SOC 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

SOC 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

SOC 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

SOC 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

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

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

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

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

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

SOC 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

SOC 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

SOC 6904:

Proseminar in Sociology

Preparation for successful completion of the Ph.D. and post-doctoral professional roles in the discipline of sociology. Employment sectors for professionals and workforce roles; pedagogical training and techniques in teaching sociology; critical writing skills, identifying publication sources and manuscript preparation requirements; roles in professional associations; proposal preparation and processes for seeking funding for sociological research; ethics in teaching and in research practice. PhD standing in Sociology.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

SOC 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

SOC 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

STATISTICS

Eric Smith, Head

Professors: Jeffrey Birch; John Morgan; Marion Reynolds; Eric Smith; Gordon Vining; William Woodall;

Associate Professors: Golde Holtzman; George Terrell;

Assistant Professors: Pang Du; Feng Guo; Yili Hong; Leanna House; Dong-Yun Kim; Inyoung Kim; Scott Leman;

Research Faculty: Christopher Franck; Eric Vance;

Affiliated Faculty: Ina Hoeschele;

Graduate Contact: chconne1@vt.edu

Director of Graduate Programs: jbbirch@vt.edu

Graduate Site: http://www.stat.vt.edu/students/gradprog.html

Student Handbook: http://www.web-e.stat.vt.edu/dept/web-e/pdf/Req_degree_10_15_10.pdf

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 Laboratory for Interdisciplinary Statistical Analysis. Over 700 master's degrees and 300 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, and environmetrics.

SPECIAL FACILITIES

Through the Laboratory for Interdisciplinary Statistical Analysis, students in cooperation with faculty members become involved in on-campus consulting activities. M.S. students are required to participate in statistical consulting 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 consulting, 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: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal, Quantitative (700.0), Analytical

The M.S. plan of study requires 34 semester hours of work, of which 31 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 course work 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 four Ph.D. concentrations or tracks, which include the Traditional Track, the Industrial Track, the Bioinformatics Track, and the Environmental 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 Industrial, Bioinformatics, and Environmental Tracks offer more specialized statistical training geared towards applications areas in which the department has particular expertise. In accord with their specialized nature, these three 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: (600.0)

Computer: (250.0)

iBT: (100.0)

GRE

General Test: Verbal, Quantitative (700.0), Analytical

The M.S. plan of study requires 34 semester hours of work, of which 31 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 course work 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 four Ph.D. concentrations or tracks, which include the Traditional Track, the Industrial Track, the Bioinformatics Track, and the Environmental 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 Industrial, Bioinformatics, and Environmental Tracks offer more specialized statistical training geared towards applications areas in which the department has particular expertise. In accord with their specialized nature, these three 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

STAT 5024:

Effective Communication in Statistical Consulting

Application of statistical design, analysis and computing methods to current interdisciplinary statistical consulting projects. Skills important to effective client-statistician interactions, including interview, report-writing and oral presentation skills, will be developed.

Credit Hour(s): 2

Lecture Hour(s): 2

Instruction Type(s): Lecture

STAT 5034:

Inference Fundamentals with Applications to Categorical Data

Fundamental ideas of statistical estimation and testing; principles and methods for standard one-sample settings; applications to categorical data problems. Topics include probability distributions, means, variances, and independence; point and interval estimation, including small and large sample procedures; hypothesis testing including exact and large-sample tests; goodness-of-fit; categorical data analysis; log-linear models; simple logistic regression.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

STAT 5334:

Exploratory and Robust Data Analysis

Analysis of data by graphical and numerical techniques, statistical analysis of non-Gaussian data, topics in robust estimation for location, regression and correlation models, and the jackknife and bootstrap techniques. CMS. Even years. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

STAT 5354:

Structured Process Improvement

An introduction to the selection, management, leadership and execution of structured process improvement projects. Topics include effective roadmaps for process improvement, team facilitation and leadership, project selection and management, sampling, process capability analysis, data transformation, variance component analysis, response surface methodology (including full and fractional factorial designs, Plackett-Burman designs, central composite designs, Box-Behnken designs, analysis of variance, regression, and multi-response optimization), and statistical process control.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

STAT 5404:

Nonparametric Statistics

Introduction to theory and methods of nonparametric statistical inference. General linear rank statistics, tests and estimation of location, dispersion, regression, and association. Selected topics. Odd years. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

STAT 5434:

Markov Chains and Renewal Theory

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

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

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

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

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. Emphasis on robustness. Use of SAS. Knowledge of CMS required. Even years. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

STAT 5514G:

Adv 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

STAT 5524:

Sample Survey Theory

Theory of sample surveys including major sampling designs, sample size determination, estimation and interval estimation, and questionnaire design. Even years. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

STAT 5524G:

Advanced Sample Survey Methods

Statistical methods for the design and analysis of survey sampling. Fundamental survey designs. Methods of randomization specific to various survey designs. Estimation of population means, proportions, totals, variances, and mean squared errors. Design of questionaires and organization of a survey are also covered.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

STAT 5554:

Variance Components

Theoretical treatment of the general problem of estimating and testing hypotheses about variance components within the framework of random effects and mixed linear models; derivation of different estimation procedures and their statistical properties; and discussion of balanced and unbalanced data and of designs for estimating variance components. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

STAT 5644:

Nonparametric Statistical Methods

Applications of rank-order statistics, sign statistics, the empirical distribution function, and runs to commonly occurring data structures. Emphasis on concepts, assumptions, comparisons to normal theory methods, and hands-on data analysis with the computer. Knowledge of CMS required. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

STAT 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

STAT 5894:

Final Examination

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

STAT 5904:

Project and Report

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

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

STAT 5974:

Independent Study

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

STAT 5984:

Special Study

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

STAT 5994:

Research and Thesis

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

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

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

STAT 6404:

Advanced Topics in Nonparametric Statistics

Topics of current interest in research for nonparametric theory and methods, using recent advanced texts and journal articles. Even years. II
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

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

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

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

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

STAT 7994:

Research and Dissertation

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

THEATRE ARTS

Patricia Raun, Head

Professors: Ann Kilkelly; Robert Leonard; Patricia Raun; Randolph Ward;
Associate Professors: John Ambrosone; William Barksdale; Patricia Lavender;
Assistant Professors: Jane Stein;

General Contact: theatre@vt.edu
Graduate Contact: rhleonar@vt.edu
Design/Tech Contact: rwward@vt.edu
Graduate Site: http://www.theatre.vt.edu/academics/mfa.html

The Department of Theatre and Cinema is a highly successful and innovative theatre program with a mission to educate and train students in and about theatre and cinema. The program 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, designed to train students for professional employment and leadership in the field and providing the terminal degree in the profession. Areas of concentration include Theatre Design and Technology (scenic, lighting, costume, technical direction, sound, visual media, and properties), Directing & Public Dialogue, and Stage Management. The M.F.A. program focuses on an individualized plan of study for each student, characterized by one-on-one tutorials, realized production work, and close mentoring by faculty artists. This is surrounded by a vision of professional theatre training that is most concerned with the formation of a specific attitude toward the artistic process, a way of thinking based on the changing realities of today's contemporary theatre. 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 MFA 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, 8-12 workshop productions, and two summer shows. In addition, students have frequent opportunities to 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 MFA 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 MFA web site (www.theatre.vt.edu/academics/mfa.html) 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 together on the Blacksburg campus, primarily in Henderson Hall, Theatre 101 - a new LEED-certified facility, and Squires Student Center. Theatre 101 and the renovated Henderson Hall were completed in the fall of 2009.

Classrooms and Labs

The newly 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 state-of-the-art 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 new 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 new public face to the campus and the town of Blacksburg.

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.

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 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 the 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

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

TA 5315:

Advanced Directing

Script analysis, theories, techniques, and practical applications of theatrical direction.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

TA 5316G:

Advanced Directing

Rehearsal techniques, style determination realism, and non-realism. Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

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

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

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

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

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

TA 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

TA 5904:

Project and Report

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

TA 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

TA 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

TA 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

URBAN AND REGIONAL PLANNING

Thomas Sanchez, Head

Professors: James Bohland; John Browder; Paul Knox; Charles Koebel; John Randolph; Jesse Richardson; Thomas Sanchez;

Associate Professors: Margaret Cowell; Casey Dawkins; Sonia Hirt; Derek Hyra; Heike Mayer; Max Stephenson; Karen Till; Kris Wernstedt; Diane Zahm;

Assistant Professors: Ralph Buehler; Elizabeth Morton; Yang Zhang;

Research Faculty: Joseph Schilling;

Visiting Faculty: Damian Pitt;

Adjunct Professors: Terry Holzheimer; Shelley Mastran; Minnis Ridenour; Derren Rosbach;

Affiliated Faculty: John Provo;

General Contact: sgraham@vt.edu

UAP Home: http://www.uap.vt.edu

Student Handbook: http://www.uap.vt.edu/students/index.html

The Master of Urban and Regional Planning (MURP) program is a two-year (48 credit hour) interdisciplinary professional degree open to students from a wide variety of undergraduate fields. The program has a dual objective of training graduates for their first planning job, and more importantly instilling conceptual and critical thinking necessary for lifelong learning and career development. While the required core provides "generalist" planning theories and skills, one-half of the curriculum is in the student's area of specialization (including: economic and community development, environmental planning and policy, international development, physical development, public and nonprofit management, and social policy and planning) and provides substantive skills in a specific area of interest. 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 program's mission is to develop in students: An understanding of the economic, social, and environmental context of planning An understanding of the history and tradition of the planning profession An understanding of the use of basic planning theories, concepts, and skills Competence in an area of specialization Competence in quantitative and qualitative analysis Competence in the written and oral communication skills necessary to function as a planning professional The UAP graduate program is offered through 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 (Roanoke, Virtual, National Capital Region, Blacksburg, Southwest Virginia, Richmond, Hampton Roads)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (79.0)

GRE

BA/MURP- Fourth-year architecture students may apply to the Graduate School for Combined Student Status provided they:1. are within 24 semester hours of graduation; 2. have elected to pursue a Master Urban and Regional Planning degree combined with B.Arch studies; and 3. have a minimum 3.0 GPA for the last two years (60 credit hours) of undergraduate studies.The MURP degree will be awarded to students who earn a 3.0 or better GPA for courses applied to it from among the core (24-25 hours), specialization (minimum 12 hours including qualifying Architecture courses taken during the 5th year), and electives as needed to accumulate 48 hours.Students must also complete a capstone project. MURPStudents must take 48 credit hours of work and complete a capstone project ---MIPStudents must take 48 credit hours of work and complete a capstone project.MURP/MNR, MURP/MPA, MURP/MLA- Simultaneous 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. In the latter case, application to the second program should be made before half the coursework in the first has been completed. Following university guidelines, the capstone product required of each program will remain in effect. However, it is recognized that the capstone product for both may bridge the fields of each degree. Both degrees must be earned simultaneously although a student could opt out of one degree program to receive the other masters degree provided requirements of that degree are fulfilled. All grades earned in dual degree status are used for purposes of determining academic good standing, academic probation and graduate requirements. Students must be in good standing in both programs to continue in a simultaneous degree program. Students who are dismissed from either program are no longer considered to be in a dual degree program. These students may enroll in and use courses for credit toward the degree program in which they are in good standing only. Students may not take courses in the program from which they have been dismissed and may not use such courses for dual degree credit.The School of Public and International Affairs offers both a Master of Urban and Regional Planning and Public and International Affairs degree in conjunction with the Peace Corps through the Masters International Program (MIP). The MIP is designed to prepare students for their Peace Corps service as well as subsequent careers in international development, international nongovernmental organization management and leadership and planning.Electives and required core courses address such subjects as community and economic development, international development planning and policy, land use and environmental planning, public and non-profit organization governance and management, NGOs in international development. Students spend one year in graduate study and the next two years overseas as Peace Corps volunteers, integrating their experience and graduate studies. Students then return to VT for their final year to complete their chosen degree.CurriculumStudents may apply to either the Master of Urban and Regional Planning (MURP) or Master of Public and International Affairs (MPIA) degree program. The Planning Accreditation Board of the American Planning Association accredits the MURP degree.

GRADUATE COURSES (UAP)

UAP 5004 (GIA 5004):

Power and Policy in the US

Social science theory and research on the distribution of power in the US, especially as it shapes important national policy outcomes. Institutional and class bases of power will be examined, including membership on corporate boards and in policy-shaping think tanks. Implications for democracy in society will be drawn. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

UAP 5034 (STS 5206) (HIST 5206) (GIA 5034) (PAPA 5034):

Democratic Governance in the Economy

An international and comparative examination of workplace and economic relations around the world, with special focus on efforts to build collaborative work processes that would extend the voice, ownership and control rights of workers. The interface between state institutions and economic organizations is also considered, especially insofar as government prescriptions and processes that may impede or

extend democratic governance of the economy. Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

UAP 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

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

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

UAP 5084G:

Advanced Community Involvement

Issues, concepts, and techniques of citizen participation in community development and planning. Theoretical foundation, instituational frameworks, and historical evolution of participatory democracy. Exercises developing group communication skills, public meeting facilitation, and design of community involvement programs. Pre-requisite: Graduate Standing Required
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

UAP 5104 (GIA 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

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

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

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

UAP 5164 (PSCI 5164) (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

UAP 5174:
Theory and Practice of Urban and Regional Planning
Theoretical foundations of urban and regional planning. Methods and procedures employed in the professional practice of planning. Examination of the interdependence of planning theory and planning practice.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

UAP 5224:
Quantitative Techniques in Planning
A presentation of research techniques used in urban and regional planning with an emphasis on predictive techniques and the use of the computer.
Credit Hour(s): 0 OR 4
Lecture Hour(s): 0 OR 3
Instruction Type(s): Lab, Lecture

UAP 5234:
Urban Economy and Public Policy
This course applies principles of urban economics and microeconomics to the analysis of a range of urban problems, including: housing, employment, environmental quality, poverty, and the provision of urban services.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

UAP 5254 (PSCI 5254) (GIA 5254):
Global Conflicts
Examines theoretical issues in the study of global conflicts. Reviews theories of nationalism, states and territory as factors. Examines dynamics of contemporary conflicts from different regions of globe as case studies illustrating theoretical issues. Reviews role of leaders in conflict processes. Graduate Standing.
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture, Online Lecture

UAP 5264:
Global Change and Local Impacts
All jurisdictions, national, regional, or local, function in an interconnected global market. Understanding the structure and interactions within that global market and the impacts therein is the focus of UAP 5264. Thematic topics include a review of welfare state functions, privatization, decentralization, and nonprofit organizations and their relation to global market dynamics. Upon completion of the courses, students will have an understanding of how global forces influence local areas and how local leaders have developed strategies to cope with their position in an increasingly global market. I
Credit Hour(s): 3
Lecture Hour(s): 3
Instruction Type(s): Lecture

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

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

UAP 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

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

UAP 5314:

Social Analysis of Land Use Planning

Examines the underlying social and cultural values which shape U.S. land use and zoning policies. Analyzes zoning ordinances, historic preservation, environmental planning, housing, and urban design policies for their explicit and cultural meanings. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

UAP 5344G:

Adv Law Critical Envir Areas

Examines the legal principles and policy debates involved in the regulation and protection of critical environmental resources. Variable topics including wetlands law and policy, endangered species habitat, open space, forestland and farmland protection, costal sone management, and floodplain regulation and policy. Pre-requisite: Graduate Standing Required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

UAP 5384:

Housing and Infrastructure Planning in the Third World

An introduction to housing problems in developing countries and alternative policy approaches to them. The course examines the formal and informal housing sectors and asks why the housing sector is important for both national governments and international organizations. It traces changes in the way housing problems have been identified and in the solutions proposed to them. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

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

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

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

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

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

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

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

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

UAP 5534:

Nonprofit Organization Leadership and Governance

Major conceptual issues related to developing an understanding of the foundations and roles of leadership and governance of third sector and nongovernmental organizations. Comparison of nongovernmental organizations in the U.S. and around the world. The course is designed to equip students with the capacities to assess and improve organizational governance effectiveness as well as to devise and implement leadership strategies in the complex structural, social and political contexts in which these organizations are typically enmeshed in the United States as well as in other industrialized democracies and in developing nations. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

UAP 5544 (PAPA 5544):

Public and Non-profit Financial Management

Examines concepts central to effective financial management of public and non-profit organizations. Affords students an opportunity to further their understanding of the relationship between financial accounting and reporting systems and effective organization management. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

UAP 5554:

Land Use Law

State enabling legislation; police power of the state; nuisance; land use regulation; subdivision regulation; exclusionary zoning; growth management; environmental controls.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

UAP 5574 (GIA 5574) (PSCI 5574):

Arts, Culture and Society

Considers the role of the arts in society, including architecture, music companies, or theater productions to heritage sites, science museums, and art galleries. Effective arts policy in revitalizing urban economies also examined. Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture, Online Lecture

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

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

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

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

UAP 5654:

Environmental Risk Analysis

This course will provide an overview of risk analysis as it pertains to environmental policy, including distinguishing among various concepts of risk, methods employed in risk analysis, public policies regarding risk analysis, the challenges of risk communication, proposed alternative approaches to risk assessment, and the political controversies surrounding risk analysis in the broad field of environmental regulation.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

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

UAP 5704:

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

UAP 5714:

Community Building Seminar

A comprehensive examination of community development theories and methods. Emphasizes community contexts across the scales of family, association, neighborhood, city, region, and nation. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

UAP 5724G:

Adv Cap Budg & Strat Fac Plan

Examines the principles and practice of capital budgeting as a primary instrument for the effecting of long-range policy objectives. Pre-requisite: Graduate Standing required

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

UAP 5744:

Planning Internship

Student placement in an organization engaged in planning or related work with the guidance of a faculty member. Pass/Fail only. Variable credit course. Maximum of three credit hours per semester, but may be repeated for a total of six credit hourse.

Credit Hour(s): 1 OR 3

Lecture Hour(s): 1 OR 3

Instruction Type(s): Lecture

UAP 5754:

Metropolitan Planning Seminar

Issues, concepts, and debates surrounding contemporary metropolitan planning and development policy through discussions, special lectures by faculty, and/or guest lectures by experts prominent in their field. May be repeated for a maximum of four credits.

Credit Hour(s): 1 TO 3

Lecture Hour(s): 1 TO 3

Instruction Type(s): Lecture

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

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

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

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

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

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

UAP 5844:

Topics in Planning History

A topics course on the history of planning. Emphasis on social, cultural, economic, legal and political influences shaping planning and planning movements from historical perspectives. May be repeated with a different topic for a maximum of 9 credits. Graduate standing required.

Credit Hour(s): 1 TO 9

Lecture Hour(s): 1 TO 9

Instruction Type(s): Lecture

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

UAP 5894:

Final Examination

I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

UAP 5904:

Project and Report

I

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

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

UAP 5924:

Peace Corp Enrollment

Credit Hour(s): 0

Lecture Hour(s): 0

Instruction Type(s): Lecture

UAP 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

UAP 5964:

Field Study

I

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

UAP 5974:

Independent Study

I

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

UAP 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 10

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

UAP 5994:

Research and Thesis

I

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

UAP 6984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

UAP 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

WOOD SCIENCE AND FOREST PRODUCTS

Audrey Zink-Sharp, Interim Head

Professors: Robert Bush; Kevin Edgar; Charles Frazier; A Hammett; David Kline; Joseph Loferski; Robert Smith; Paul Winistorfer; Audrey Zink-Sharp;

Associate Professors: Brian Bond; Urs Buehlmann; Daniel Hindman; Maren Roman;

Assistant Professors: Henry Quesada Pineda; Scott Renneckar;

Emeritus Faculty: Wolfgang Glasser; Geza Ifju; Fred Lamb; Marshall White;

General Contact: garnandd@vt.edu

Student Handbook: http://www.woodscience.vt.edu/students/graduate/

The Department of Wood Science and Forest Products is one of the leading academic program in North America. We support a large graduate education program where students are engaged in research. Because of the nature of wood as a material, 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 wood science and forest products, spanning the range from nanotechnology and the basic science of wood as a material, through processing, manufacturing, marketing, management, and competitiveness aspects of the forest products industry. 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, Wood Composites, Wood 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 teaching in Blacksburg, Virginia and other locations across Virginia. Plans are underway for construction of a new facility devoted entirely to our department. Currently, 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 shortcourses plus forestry 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-research degree intended to serve the needs of (1) those who have a prior wood science and forest products degree and who wish to enhance their knowledge and skills, or (2) those who have no previous degree in wood science and forest products. 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 QCA 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 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' (CNR) 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. 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' (CNR) Graduate Program Procedures. A 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 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.

MS Degree

Offered In (Blacksburg)

TOEFL

Paper: (550.0)

Computer: (213.0)

iBT: (80.0)

GRE

General Test: Verbal, Quantitative, Analytical

All program degree requirements and supplemental information about graduate education in our department is summarized in our annually updated Graduate Student policy and Procedures manual, available online on our department website. This manual describes all required coursework, requirements and activities associated with graduate education in our department. The department offers three degrees: Master of Forestry (M.F.), Master of Science (M.S.) in Forestry and Forest Products, and Doctor of Philosophy (Ph.D.) in Forestry and Forest Products. The M.S. and Ph.D. degrees require students to prepare a thesis or dissertation, and considerable time spent working for these degrees is devoted to research. The M.F. degree is a professional, non-research degree for those who wish to expand their post-baccalaureate education.Master of Forestry The M.F. is a non-research degree intended to serve the needs of (1) those who have a prior wood science and forest products degree and who wish to enhance their knowledge and skills, or (2) those who have no previous degree in wood science and forest products. 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 QCA 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 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' (CNR) 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. 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' (CNR) Graduate Program Procedures. A 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 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.

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-research degree intended to serve the needs of (1) those who have a prior wood science and forest products degree and who wish to enhance their knowledge and skills, or (2) those who have no previous degree in wood science and forest products. 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 QCA 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 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' (CNR) 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. 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' (CNR) Graduate Program Procedures. A 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 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 (WOOD)

WOOD 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. I,II

Credit Hour(s): 1

Lecture Hour(s): 1

Instruction Type(s): Lecture

WOOD 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

WOOD 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

WOOD 5314:

Physical and Mechanical Behavior of Wood

Physical and mechanical properties of wood. Thermodynamics and theories of moisture sorption and measurement. Hygroexpansion. Transport of fluids, heat, and electricity. Orthotropic elasticity and structure. Mechanics of solid wood axial, bending, and torsion elements. Failure mechanisms, rheological behavior, and environmental effects. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

WOOD 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. I

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

WOOD 5414:

Advanced Wood Chemistry and Structure

Structure and ultrastructure of wood. Chemical properties and reactions of tree constituents. Non-destructive methods for wood (and plant) analysis. Description of processes for the selective removal of wood components. Biotechnological applications for wood and biomass. I

Credit Hour(s): 0 OR 4

Lecture Hour(s): 0 OR 3

Instruction Type(s): Lab, Lecture

WOOD 5424 (GIA 5444) (CHEM 5424) (PSCI 5444):

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

WOOD 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. II

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

WOOD 5894:

Final Examination

Credit Hour(s): 3

Lecture Hour(s): 3

Instruction Type(s): Lecture

WOOD 5954:

Study Abroad

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture

WOOD 5974:

Independent Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Independent Study

WOOD 5984:

Special Study

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Instruction Type(s): Lecture, Online Lecture

WOOD 5994:

Research and Thesis

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research

WOOD 7994:

Research and Dissertation

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Instruction Type(s): Research