

# 2016-2017 Undergraduate Course Catalog and Academic Policies

**Agriculture & Life Sciences**

**Architecture & Urban Studies**

**College of Engineering**

**Liberal Arts and Human Sciences**

**Natural Resources and Environment**

**Pamplin College of Business**

**College of Science**

**Veterinary Medicine**

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Academic Calendars

[Calendar 2016-2017](#)

[Calendar 2017-2018](#)

### Calendar 2016-2017

#### Fall 2016

Monday	August 22	Classes Begin
Monday	September 5	Labor Day (No Classes; University Offices Closed)
Friday	October 14	Fall Break Begins (No Classes; University Offices Open)
Sunday	October 16	Fall Break Ends
Saturday	November 19	Thanksgiving Break Begins
Sunday	November 27	Thanksgiving Holiday Ends
Wednesday	December 7	Classes End
Thursday	December 8	Reading Day
Friday	December 9	Exams Begin
Thursday	December 15	Exams End
Friday	December 16	University and Graduate School Commencement Ceremonies

#### Winter 2017

##### *Virtual, Blended, or Winter Experience (VBW)*

Monday	December 26	Classes Begin
Friday	January 13	Classes End
Saturday	January 14	Exam Day

##### *Residential (Blacksburg)*

Monday	January 2	Classes Begin
Friday	January 13	Classes End

Saturday	January 14	Exam Day
<b>Spring 2017</b>		
Monday	January 16	Martin Luther King Holiday (No Classes; University Offices Closed)
Tuesday	January 17	Classes Begin
Saturday	March 4	Spring Break Begins
Sunday	March 12	Spring Break Ends
Wednesday	May 3	Classes End
Thursday	May 4	Reading Day
Friday	May 5	Exams Begin
Wednesday	May 10	Exams End
Thursday	May 11	Graduate Commencement Ceremony and Senior Day
Friday	May 12	University Commencement and College/Departmental Ceremonies
Saturday	May 13	College and Department Commencement Ceremonies
Sunday	May 14	National Capital Region Commencement Ceremony

## Summer 2017

### **Summer I**

Monday	May 22	Classes Begin
Monday	May 29	Memorial Day Holiday (No Classes)
Thursday	June 29	Classes End
Friday	June 30	Exams Begin
Saturday	July 1	Exams End

### **Summer II**

Wednesday	July 5	Classes Begin
Friday	August 11	Classes End
Saturday	August 12	Exams Begin
Monday	August 14	Exams End

## Calendar 2017-2018

### Fall 2017

Monday	August 28	Classes Begin
Monday	September 4	Labor Day (Classes WILL Meet)
Friday	TBA	Fall Break Begins (No Classes; University Offices Open)
Sunday	TBA	Fall Break Ends
Saturday	November 18	Thanksgiving Break Begins
Sunday	November 26	Thanksgiving Holiday Ends
Wednesday	December 13	Classes End
Thursday	December 14	Reading Day
Friday	December 15	Exams Begin
Wednesday	December 20	Exams End

Thursday	December 21	University and Graduate School Commencement Ceremonies
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## Winter 2018

### *Virtual, Blended, or Winter Experience (VBW)*

Tuesday	December 26	Classes Begin
Friday	January 12	Classes End
Saturday	January 13	Exam Day

### *Residential (Blacksburg)*

Tuesday	January 2	Classes Begin
Friday	January 12	Classes End
Saturday	January 13	Exam Day

## Spring 2018

Monday	January 15	Martin Luther King Holiday (No Classes; University Offices Closed)
Tuesday	January 16	Classes Begin
Saturday	March 3	Spring Break Begins
Sunday	March 11	Spring Break Ends
Wednesday	May 2	Classes End
Thursday	May 3	Reading Day
Friday	May 4	Exams Begin
Wednesday	May 9	Exams End
Thursday	May 10	Graduate Commencement Ceremony and Senior Day
Friday	May 11	University Commencement and College/Departmental Ceremonies
Saturday	May 12	College and Department Commencement Ceremonies
Sunday	May 13	National Capital Region Commencement Ceremony

## Summer 2018

### *Summer I*

Monday	May 21	Classes Begin
Monday	May 28	Memorial Day Holiday (No Classes)
Thursday	June 28	Classes End
Friday	June 29	Exams Begin
Saturday	June 30	Exams End

### *Summer II*

Monday	July 2	Classes Begin
Wednesday	July 4	Independence Day (No Classes)
Thursday	August 9	Classes End
Friday	August 10	Exams Begin
Saturday	August 11	Exams End



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Academic Policies

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## Academic Common Market Programs

Virginia Tech has discontinued participation in the Academic Common Market for all majors effective fall 2012.

Undergraduate students currently approved for participation in an Academic Common Market (ACM) major may continue to receive benefits as long as they are continuously enrolled full time in the ACM approved major (not to exceed six (6) years following this discontinuance), maintain a 2.0 overall grade point average, and satisfactory progress toward the degree.

## Academic Eligibility

Continued enrollment at Virginia Tech is a privilege that is granted as long as the student is making satisfactory progress toward a degree, maintenance of the required minimum Grade Point Average (GPA), and compliance with all regulations stipulated in the *University Policies on Student Life*.

The minimum standard for good standing is eligibility to enroll. The required minimum grade point average is 2.00. Students on academic probation and warning are eligible for continued enrollment and good standing (absent any violations of regulations stipulated in the *University Policies on Student Life*).

**Academic Warning:** Students earning less than a 2.0 term GPA, but with a cumulative grade point average of 2.0 or higher, will be placed on academic warning without notation on the academic transcript. Students on academic warning will be required to consult with the appropriate undergraduate assistant or associate dean of their college and to sign an academic contract. Failure to complete an action plan (academic contract) may result in prohibition from future enrollment(s).

**Academic probation** is imposed when the cumulative GPA is less than 2.00; academic probation is lifted when cumulative GPA is at least 2.00. Academic performance will be reviewed at the end of each regular semester (fall and spring).

A student on **probation:**

1. may take no more than 16 credits per semester;
2. may be required (at the discretion of individual colleges) to consult with an advisor before beginning a probationary semester, and to sign an academic contract acknowledging his/her performance is not meeting university standards and stating what actions she/he is committed to taking to improve performance.

**First suspension** will be imposed whenever one of the following occurs:

1. A student on academic probation has a cumulative GPA less than 2.00 for the first 2 semesters (fall, spring) of enrollment; or
2. A student has 2 consecutive semesters thereafter with a cumulative GPA below 2.00.

**First Suspension (Fall):** A student who is placed on first academic suspension at the end of fall semester will be suspended from continued enrollment through the end of the following spring semester. **Note:** Students placed on first academic suspension at the end of fall semester are eligible to return the subsequent first summer, second summer, or fall semester.

**First Suspension (Spring):** A student who is placed on first academic suspension at the end of spring semester will be suspended from continued enrollment through the end of the following fall semester. **Note:** students placed on first academic suspension at the end of spring semester may NOT enroll in the immediately following summer session.

A student must earn a minimum 2.00 semester GPA the first semester back and raise the cumulative GPA to at least 2.00 by the end of the second semester back or earn a 2.50 GPA for every semester following the suspension until cumulative GPA is 2.00 or greater. A student will be placed on **second academic suspension** for failure to meet returning performance requirements.

**Second Suspension (Fall):** A student who is placed on second academic suspension at the end of fall semester will be suspended from continued enrollment through the end of the following fall semester. **Note:** students placed on second academic suspension at the end of fall semester may NOT enroll in the immediately following summer session.

**Second Suspension (Spring):** A student who is placed on second academic suspension at the end of spring semester will be suspended from continued enrollment through the end of the following spring semester. **Note:** students placed on second academic suspension at the end of spring semester may NOT enroll in the immediately following summer session. The same returning performance requirements apply for second suspension as for first suspension.

**Final Suspension:** A student will be permanently dismissed for failure to meet returning performance requirements after a second academic suspension.

## Academic Eligibility Appeals

The University Appeals Committee is comprised of the associate deans of undergraduate studies of the academic colleges and one faculty member appointed by the Vice Provost for Undergraduate Academic Affairs. A representative of the Dean of Students Office participates as a non-voting member of the committee to provide information and background available through the Dean of Students Advocacy team. The University Appeals Committee is an advisory committee to the Vice Provost for Undergraduate Academic Affairs.

Students who are suspended due to academic eligibility at the end of Fall or Spring terms may appeal their suspension to the University Appeals Committee. Any appeal for exceptions to the policy must be based on clear extenuating circumstances beyond a student's control that negatively impacted academic performance. If an appeal is based on physical, psychiatric, or disability/learning disability reasons, the appeal must be reviewed by the Health Evaluating Committee. A recommendation letter from the appropriate office is required to complete an appeal petition.

Students must complete an academic appeals petition and submit all required documentation to the associate dean of their major college by the published college deadline. Failure to meet the published deadline results in the loss of opportunity to appeal for the term. Students have a right to appear in person at the appeals meeting. Students may not bring an outside advocate to an appeals meeting.

Full instructions and forms for academic appeals are posted on each academic college website along with the dates of the academic appeals meetings. The associate dean of the student's major college may require a preliminary meeting to discuss the appeal. The associate dean also may establish an independent submission deadline prior to each University Appeals committee meeting.

If the University Appeals Committee denies an appeal, the student may request further consideration of the academic appeal by the provost's representative. The decision of the provost's representative is final.

## Accreditation

Virginia Tech is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award doctorate, masters, baccalaureate and associate degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of Virginia Tech.

Department	Program Description	Accred. Agency	USDOE Specialized Accred. Agency	Accred. Period	OnCampus Contact	Next Accred. Period
<b>College of Agriculture and Life Sciences</b>						
Agricultural and Applied Economics	Bachelor of Science in Applied Economic Management - Financial Planning Option	Certified Financial Planner Board of Standards, Inc.	No	2015-2017	Dr. Ruth Lytton	

Human Nutrition, Foods, and Exercise	Dietetic Internship	American Dietetic Association	Yes	2013-2018	Dr. Carol Papillon	
Human Nutrition, Foods, and Exercise	Didactic Program in Dietetics (DPD) at the baccalaureate level	American Dietetic Association	Yes	2013-2018	Heather Cox	
<b>College of Architecture and Urban Studies</b>						
Architecture	Bachelor of Architecture (5 year professional degree; 160 undergraduate credits)	National Architectural Accreditation Board (NAAB)	No	2012-2018	Henri de Hahn	2018
Architecture	Master of Architecture 2 (pre-professional degree + 54 graduate credits)	National Architectural Accreditation Board (NAAB)	No	2012-2018	Henri de Hahn	2018
Architecture	Master of Architecture 3 (non-pre-professional degree + 84 credits)	National Architectural Accreditation Board (NAAB)	No	2012-2018	Henri de Hahn	2018
Building Construction	Bachelor of Science, Building Construction Science & Mgmt (MS), Environmental Design & Planning (PhD)	American Council for Construction Education (ACCE)	No	2011-2017	Yvan Beliveau	
Center for Public Administration and Policy	Master of Public Administration	National Association of Schools of Public Affairs and Administration (NASPAA)	No	2009-2012	Karen Hult	2016
Interior Design Program	Bachelor of Science	Council for Interior Design Accreditation	No	2012-2018	Lisa Tucker	2018
Landscape Architecture	Bachelor of Landscape Architecture	Landscape Architectural Accreditation Board (LAAB)	No	2007-2013	Brian Katen	Currently in progress
<b>Pamplin College of Business</b>						
Accounting	Undergraduate, Masters, and Ph.D. Programs	Association to Advance Collegiate Schools of Business International (AACSB International)	No	2015-2019	Dr. Reza Barkhi	
Finance	Bachelor of Science in Business, CFP Certification Education	Certified Financial Planner Board of Standards, Inc.	No	2015-2017	Dr. Ruth Lytton and/or Derek	



	Track				Klock	
General	Undergraduate, Master, and Ph.D. Programs	Association to Advance Collegiate Schools of Business International (AACSB International)	No	2015-2019	Dean Robert Sumichrast	
<b>College of Liberal Arts and Human Sciences</b>						
Communication	B.A. in Communication, Public Relations major	Public Relations Society of America	No	2013-2019	Dr. Robert E. Denton, Jr.	
School of Education	All school preparation programs + initial teacher preparation and advanced levels	National Council for Accreditation of Teacher Education (NCATE) - current accreditation. Next accreditation is with the Council for the Accreditation of Educator Preparation (CAEP)	Yes	2011-2018	Dr. Nancy Bodenhorn	
School of Education	All school preparation programs + initial teacher preparation and advanced levels	Virginia Department of Education (VDOE)	No	2015-Present	Dr. Nancy Bodenhorn	
School of Education	Counselor Education (MA and PhD)	Council for Accreditation of Counseling and Related Educational Programs (CACREP)	No	2015-2017	Dr. Gerard Lawson	
Gerontology	Graduate Degree Program	Association for Gerontology in Higher Education	No	2000-present	Dr. Rosemary Blieszner	
Human Development	Master's Degree (in Northern Virginia)	Commission on Accreditation for Marriage and Family Therapy Education (COAMFTE)	No	2013-2019	Dr. Eric McCollum	
Human Development	Ph.D. Program (in Blacksburg)	American Association for Marriage and Family Therapy (AAMFT)	No	2010-2016	Dr. Scott Johnson	
Music	Bachelor's Degree (Music)	National Association of Schools of Music, Commission on Accreditation (NASM)	Yes	2005-2016	Dr. William J. Crone	
	Army ROTC is not a degree producing			2014-Present		

ROTC - Army	program. However; Upon successful completion of a degree from Virginia Tech, we offer a Commission (as a 2LT) into the United States Army.	U.S. Army Cadet Command	No	(Continual) Based upon the Active Duty Orders of the Officers / Instructors assigned to this unit.	COL Kevin W. Milton or Ms. Debra Harry	
Theatre Arts	Bachelor's Degree (Theatre Arts)	National Association of Schools of Theatre (NAST)	Yes	2009-2018	Prof. Patricia Raun	
<b>College of Natural Resources &amp; Environment</b>						
Forest Resources and Environmental Conservation	Bachelor of Science - Forestry Major: Forestry Resource Management Option	Society of American Foresters	No	2016-2025	Dr. Janaki Alavalapati	
Forest Resources and Environmental Conservation	Bachelor of Science - Forestry Major: Urban Forestry Option	Society of American Foresters	No	2016-2025	Dr. Janaki Alavalapati	
Forest Resources and Environmental Conservation	Professional Forestry Degree (PFD): Forest Operations and Business Option	Society of American Foresters	No	2016-2025	Dr. Janaki Alavalapati	
Sustainable Biomaterials	Bachelor of Science	Society of Wood Science and Technology	No	2015-2025	Dr. Audrey Zink-Sharp	
<b>College of Science</b>						
Chemistry	Bachelor of Science	American Chemical Society	No	2014-2020	Dr. Jim Tanko and Dr. Gordon Yee	
Psychology	Clinical Training Program, Clinical Psychology	American Psychological Association	Yes	2014-2021	Dr. Bob Stephens	
<b>College of Veterinary Medicine</b>						
Full college accreditation	Full college accreditation	American Veterinary Medical Association (AVMA)	Yes	2015-2022	Dr. Jennifer Hodgson	
Public Health	Master of Public Health	Council on Education for Public Health	Yes	2013-2018	Dr. Francois Elvinger	
<b>Outreach and International Affairs</b>						
Language and Culture	The Virginia Tech Language and Culture Institute provides	Commission on				

Institute/English Language Program	language-related programs and services for academic and professional development.	English Language Program Accreditation	Yes	2008-2017	Donald C. Back	
<b>Virginia Tech</b>						
University accreditation	University accreditation	Southern Association of Colleges and Schools (SACS)	Yes	2010 - 2019	Dr. Kenneth Smith	

## Applying for Your Degree

All students must apply for a degree during the first semester of their junior year. The application for degree can be found on Hokie SPA under the Degree Menu. Once students have completed the application, they should generate a Degree Audit Report (DARS). The DARS report will help students to be fully aware of all degree requirements which remain to be completed. This report can also be generated through the Hokie Spa.

**Double Major(s):** Undergraduate students who satisfy graduation requirements for two curricula concurrently may request recognition of the second major on their transcripts (also known as "double major"); however, only the primary major will appear on the diploma. Students earning multiple majors concurrently will receive a double major certificate(s).

**Second Undergraduate Degree:** Students may earn a second bachelor's degree (and diploma) by earning a minimum of 30 additional credit hours in **residence** with a minimum 2.0 GPA on all work attempted. All specific requirements must be met for each degree program, including attainment of the 2.0 GPA for all courses in the major. Note: threshold for total number of pass/fail hours allowed may not exceed the maximum for the first degree.

Traditionally, degrees are conferred upon candidates who are present to receive them at the Commencement ceremony in May. Candidates may have their degrees conferred in absentia if they cannot be present at Commencement. To arrange for this, a candidate must indicate to the University Registrar either via Hokie SPA or in writing to be excused from the Commencement ceremony.

In addition to the traditional Commencement, other "Degree Conferral Dates" have been established for each May to May year. The degree conferral dates for fall, winter, first summer, and second summer appear on the diplomas of qualified graduates. The degree conferral dates fall on the last day of final examinations (last day of term) for first summer session, second summer session, fall semester, and winter term. Names of Graduates of Summer and Fall terms will appear in the Fall Commencement Ceremony Program only.

No commencement ceremonies are conducted at the end of the summer sessions, but graduates may attend the fall ceremony after completion of degree requirements. They may also request permission from the department to "walk through" the spring Commencement ceremony based on established departmental or college guidelines. Diplomas are not distributed.

**Completion of degree requirements** is determined after the final grade reports are available. Degrees are regarded as having been conferred on the appropriate conferral date upon determination by the University Registrar that degree requirements have been met. All course enrollments and attendance obligations must have been completed on or before the degree conferral date. University actions, such as Honor System or Conduct System penalties, will delay the awarding of the degree, the effective term of the degree and release of the diploma. Students with university actions will have their final degree conferral date moved in accordance with the completion of sanctions and/or penalties. Students who are unable to complete based on original application for degree term are responsible for moving their date of completion.

Students may resolve degree completion programs up to thirty (30) days after the degree term to retain the conferral date on the diploma. Any resolutions of degree completion following the thirty day resolution window will be conferred on the next subsequent term following resolution of the problem(s). Resolutions of degree

problems include failure to submit appropriate paperwork to the university.

With the exception of spring, diplomas for all other "Degree Conferral Dates" are ordered after course work completions are established. Diplomas are distributed either by mail or in person to graduates who appear in the Office of the University Registrar, or at the next Commencement ceremony, if available.

## Assessment of Student Learning Experiences

A critical element in the continuous improvement of programs and services at Virginia Tech is the evaluation of student learning experiences, perceptions, and academic achievement. Each student may be asked to participate in assessment activities, including but not limited to course assignments, surveys, focus groups, end of course evaluations, tests, and personal interviews. Student involvement in these assessment activities will assist Virginia Tech in providing current and future students with high-quality learning experiences in keeping with the mission of the University.

## Combination Degrees

The bachelor's degree will be awarded to a student who has satisfactorily completed three years of undergraduate work in an appropriate curriculum and the first year of work in an accredited medical, dental, veterinary, or law school, or medical technology program (biology majors only), or physical therapy program (biology majors only), provided the student fulfills the requirements for the three-year program as follows:

- At least two of the three years of pre-professional work, including the third year, in residence at the university.
- A minimum of 90 semester hours undergraduate work, i.e. pre-professional school credit.
- Curriculum for Liberal Education requirements plus 18 of the 30 hours required in the major during the three-year, pre-professional work program. A department may require more than 18 hours of course work in the major.

## Degree Programs

Virginia Tech offers four-year degree programs leading to a Bachelor of Arts, Bachelor of Science, or Bachelor of Fine Arts degree. Also offered are five-year Bachelor of Architecture and Bachelor of Landscape Architecture programs. Virginia Tech also offers graduate work in 63 fields of study leading to master's degrees and in 51 fields leading to the doctorate. The professional doctor of veterinary medicine is offered through the Virginia-Maryland Regional College of Veterinary Medicine, located at Virginia Tech.

## Directed and Independent Enrollment

Students develop a plan of work to reach particular objectives, obtain approval of both the department and a faculty member who will supervise the work, and work with them to arrange hours and credits.

Students must submit an official approval form prior to registration. In most cases, the student's first contact for an independent study, field study, or undergraduate research course is the department offering the course. Registration is through the student's dean's office. Special study courses are set up by the department, and the student registers through web course request. Some colleges and departments have restrictions on eligibility to register for these courses, and limit the number of hours that can be used toward graduation.

**Field Study (X964)** courses are work experiences approved by some departments and are selected to augment traditional classroom activities. The student is evaluated on the knowledge and skills acquired as a result of the experience. Emphasis is placed on the academic and practical value of the work.

**Independent Study (X974)** courses generally involve extensive reading and tutorial sessions with the faculty supervisor and also may involve written papers. The subject of Independent Study usually is a continuation in greater depth of a topic covered in a regular course, allowing students to study topics of particular individual

interest.

**Special Study (X984)** courses are designed for a group of students, rather than for a single individual. This type of course may be used to study a timely topic, one in which there is current, but not necessarily lasting, interest. It also may be used to launch an experimental course before the course is incorporated into the regular curriculum.

**Undergraduate Research (X994)** courses are individual research projects carried out by students under faculty supervision. The student defines the research topic, proposes a methodology, carries out the research, and writes a report.

## Global Education

Virginia Tech students have the opportunity to study abroad through various programs spanning the globe.

Study abroad programs touch on almost every academic discipline and provides the opportunity to develop or strengthen global competency. Students can experience an academic discipline at work in an international setting, improve language skills, cultivate new intellectual interests, challenge assumptions about one's own and foreign cultures, and build intercultural communication skills of value to future employers.

The Steger Center for International Scholarship in Switzerland provides a unique place for undergraduate students to live and study. Curriculum for Liberal Education and specialized programs in architecture, geosciences and the humanities are offered at the Steger Center. Students study for one semester at the university's center located in the town of Riva San Vitale, Switzerland. The central location allows for visits to other European sites which complement classroom instruction.

Faculty-led programs provide another option for international experience. Virginia Tech faculty design and teach short-term courses abroad during the winter or summer terms. Participants in faculty-led programs have the ability to focus on a specific course or discipline while navigating the culture along with a faculty member and fellow Hokies.

Additionally, Virginia Tech has partnerships with 50+ universities around the world. A bilateral exchange offers the opportunity for students to spend a semester or academic year abroad at a host university. Students are immersed in local classroom, culture and community. Students who participate in bilateral and ISEP student exchange programs pay the same tuition and fees that they would pay for a regular term at the Virginia Tech main campus. Some of the more popular locations for exchanges include Australia, Ecuador, France, Germany, Italy, Spain and the United Kingdom.

Semester/academic year programs are also available through other study abroad third-party or non-Virginia Tech providers.

Students should meet with an academic advisor early in the study abroad planning process to determine how classes taken abroad will fit into a degree program and how credit is awarded. All credits to be transferred to Virginia Tech for use toward degree completion should be pre-approved. In order to receive credit for a study abroad experience, an official transcript must be received from an accredited college or university in the U.S. It may also be possible to receive credit, if the institution is recognized by the Ministry of Education and authorized to grant degrees in the country in which the institution is located. Only courses with an equivalent grade of "C" or better can transfer. Credits may transfer, but grades do not. A minimum of 25% of the credits for the degree must be earned at Virginia Tech.

Apart from credits, students and parents considering study abroad programs typically have questions regarding costs. Program costs can vary largely depending on various factors including location, length and program type. Most forms of financial aid may be applied to study abroad, and there are several scholarships and grants available. Students are encouraged to contact the Office of Scholarships and Financial Aid as soon as they consider studying abroad.

The Global Education Office strives to strengthen the university's mission of global engagement, discovery, and service by connecting faculty and students to peers abroad; inspiring and contributing to the faculty's

creation and promotion of cross-cultural learning experiences; and supporting the development of Virginia Tech students into globally competent citizens. For more information, contact the Global Education Office at 526 Prices Fork Road, Room 131, or consult: [www.globaleducation.vt.edu](http://www.globaleducation.vt.edu).

## Graduation Requirements and Degree Conferrals

The approved requirements in effect for the term/year of application of degree apply. A student must complete all courses with at least a minimum 2.0 GPA for all hours attempted. In addition, a student must present an equally satisfactory record in courses attempted in the major and/or any minor. The number of credit hours required varies by major curriculum. Virginia Tech reserves the right to modify requirements in the student's program if necessary. Requirements for program's degree must be approved two years prior to their effective graduation date. The approved graduation requirements (referenced as graduation "Checksheets") appear at the University Registrar website: <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

All students earning degrees from Virginia Tech must have earned a minimum of twenty-five (25) percent of the credit for their respective degrees from this institution. No more than fifty (50) percent of credit hours may be transferred from a two year institution. Students who must enroll in foreign language courses to complete admission requirements may not use the credits toward completion of the degree.

Undergraduate students are permitted to complete a maximum of 18 of their last 45 hours *in absentia* and to transfer to complete their graduation requirements, so long as the request to transfer these credits meets all the current requirements in effect (transfer transcript is required and approval of the student's Academic Dean). Also the credits to be transferred may consist of required as well as elective credits as long as prior approval has been obtained from the student's Academic Dean to transfer any required credits. Undergraduate students studying away from campus during their last 45 hours may apply for an individual waiver of the requirement that a maximum of 18 of their last 45 hours may be earned *in absentia*. Approval of the request will be at the discretion of their academic dean. This does not preclude the requirement that at least 25% of all credits be earned in residence at Virginia Tech.

**Graduation with Distinction** (Academic Policies Governing Enrollment Section)

### Language Study Requirement

Students must meet a language study requirement either through high school enrollment or prior to receipt of the undergraduate degree. The minimum requirement may be met in high school by completing 2 units of a single foreign or classical language or American Sign Language. Some majors in the College of Liberal Arts and Human Sciences may require 3 units of a single foreign or classical language or American Sign Language. Students completing the requirement at Virginia Tech may not count the hours toward degree completion. The requirement also may be met after admission by one of the following:

- Earning six (6) semester hours of college-level foreign or classical language credit or American Sign Language. Such credits are in addition to that number normally required for graduation in a student's program of study.
- Receiving credit by examination for a foreign or classical language or American Sign Language. The credit by examination option is available only to students who have gained knowledge of a foreign language without the benefit of formal training. This privilege is intended to recognize informal non-academic learning experience and is **not** offered to a student who has had regular classroom instruction in that foreign language. (Contact the Department of Foreign Languages and Literatures for more information.)

### Honor Code and Honor System

The Virginia Tech Honor Code is the university policy that defines the expected standards of conduct in academic affairs. The Virginia Tech honor pledge is as follows: "*As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do.*" Further, students are prohibited from giving and/or receiving unauthorized assistance on their course work.

Each student who enrolls at Virginia Tech is responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any graded assignment is responsible for obtaining specific guidance from the instructor before submitting the assignment for evaluation. Students should assume that all projects and homework assignments are to be completed individually unless otherwise specified by the instructor.

Commission of any of the following acts shall constitute academic misconduct. This listing is not, however, exclusive of other acts that may reasonably be said to constitute academic misconduct.

- **CHEATING** - The intentional use of unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise, or attempts thereof.
- **PLAGIARISM** - The copying of the language, structure, programming, computer code, ideas, and/or thoughts of another and passing off the same as one's own original work, or attempts thereof.
- **FALSIFICATION** - The statement of any untruth, either verbally or in writing, with respect to any element of one's academic work, or attempts thereof.
- **FABRICATION** - Making up data and results, and recording or reporting them, or submitting fabricated documents, or attempts thereof.
- **MULTIPLE SUBMISSION** - The submission for credit without authorization of the instructor receiving the work of substantial portions of any work (including oral reports) previously submitted for credit at any academic institution, or attempts thereof.
- **COMPLICITY** - Intentionally helping another to engage in an act of academic misconduct, or attempts thereof.
- **VIOLATION OF UNIVERSITY, COLLEGE, DEPARTMENTAL, PROGRAM, COURSE, OR FACULTY RULES** - The violation of any University, College, Departmental, Program, or Faculty Rules relating to academic matters that may lead to an unfair academic advantage by the student violating the rule(s).

Instances of academic misconduct represent behavior that is of an especially serious nature. The University's normal sanction for academic misconduct is an F\* as the student's final course grade. The F\* sanction is intended to identify a student who has failed to uphold the values of academic integrity at Virginia Tech. A student who is assessed a sanction of F\* as their final course grade shall have it documented on their transcript with the notation "FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION." More severe or lesser penalties may be imposed if the circumstances warrant.

The Honor Code fosters an environment that promotes fairness, personal responsibility, and integrity. More information about the Honor Code is available at [www.honorsystem.vt.edu](http://www.honorsystem.vt.edu).

## Pre-Professional Preparation

## Restricted Majors and Programs

Students should be aware that there are some academic majors and programs within the university that have strict entrance requirements or are in such high demand that they cannot accommodate all who wish to enter them. Administrators of these restricted programs must be selective in allowing students to transfer in from other majors within the university and in permitting second majors or minors. Students seeking entrance into such restricted programs should consult the appropriate department.

Restricted programs for internal transfers are as follows:

### **College of Agriculture and Life Sciences**

Human Nutrition, Foods and Exercise

### **College of Architecture & Urban Studies**

Architecture

Art (Visual Communication Design; Studio Art)

Industrial Design - major

Industrial Design - minor  
Interior Design - major  
Landscape Architecture

### **Pamplin College of Business**

Accounting  
Business Information Technology  
Business Minor  
Finance, Ins, & Bus Law  
Hospitality and Tourism Management  
Management  
Marketing

### **College of Engineering**

All Engineering Majors

### **College of Science**

Biological Sciences

## Selecting/Changing a Major, Double Major, or Minor

Undergraduate students must be enrolled in their major(s) of choice prior to the beginning of their senior year, or by the time they have 30 semester hours to complete before their graduation. Students seeking double majors must be accepted into the second major by the academic department before the university can award the second major.

Changes from one degree program to another (i.e., changes in major) or the addition of a second major usually can be accomplished prior to the senior year, simply by working with one's academic advisor and informing the head(s) of the department(s) and the dean(s) of the college(s) in question. A major (or second major) cannot be selected after the beginning of the senior year. (See section above on Selecting a Major.) Some departments establish specific deadlines for requesting change of major. Check the department's website for specific deadlines and required application materials.

Minors are offered by many academic departments and earned simultaneously with the degree. Minors are not declared nor earned after degree completion. Refer to the section on Graduation Requirements and Degrees and to the appropriate academic department in the college chapters of this catalog to review the requirements for a minor.

Students should be aware that changes, such as changing or adding majors or minors, sometimes imply extra course work, which can delay graduation.

Twenty-five percent of the student's total hours required for degree must be taken at Virginia Tech.

### **Procedures to Follow When Changing or Adding a Major or Minor**

Students should submit their applications for changing majors or adding minors two weeks prior to the start of each semester's registration period. This will allow students adequate time to assess their situations before deciding to transfer and registering for the following term.

The procedure for changing majors or adding a minor is as follows:

1. Request an "Application for Change in Curriculum" from the office of the dean of your new curriculum.
2. Follow the instructions given on the "Application for Change in Curriculum" form.

## **Selection of Studies**

The regular academic year at Virginia Tech is divided into two semesters, fall and spring. Virginia Tech also offers two summer sessions. Most courses of study require eight (8) terms (i.e., semesters and/or summer



sessions) for completion of the bachelor's degree requirements. Completion of the degree requirements for those students who enroll in the Cooperative Education Program, Bachelor of Architecture Program, or Bachelor of Landscape Architecture Program requires five years.

Elective courses are chosen through consultation with the student's advisor. The dean of the college in which a student is registered has authority in such matters as substitution of courses, dropping and adding courses after deadlines, or permission to take an overload.

Students have the assistance of faculty guidance, introductory courses, and special counseling to help them choose wisely which course of study they should take. Every effort is made to assure that all courses listed under the various department of instruction will be offered. Virginia Tech reserves the right, however, to withdraw any course for which an adequate number of students do not enroll.

## Student Responsibilities on Official Student Records

Students are responsible for keeping and being familiar with their own records and for the accuracy of these records.

A student's failure to keep his/her address updated does not absolve the student of responsibility for matters which require notification by the university. Changes to your local address, permanent address, or parent/guardian address should be promptly updated by accessing Hokie SPA. Correct dorm addresses are established through the Housing and Residence Life Office in New Hall West. If you are not sure what addresses are on file, you may check Hokie SPA for verification. Virginia Tech requires updating of local address, designation of emergency contact, opt in/out of VT Alerts, and understanding of the University Policy on Student Life (UPSL) prior to registration.

It is the student's responsibility to check his/her current schedule of classes by accessing Hokie SPA. Errors must be corrected by the established deadline stated in the Timetable of Classes. Request for course(s) will result in a responsibility for payment of tuition and fees. If a student requests courses via course request or during dropadd, the student is responsible for the tuition and fees assessed unless formally resigning during the established university deadlines. It is the student's responsibility to complete and return the Withdrawal/Resignation form by established term deadlines if choosing to disenroll for a given term.

Students are responsible for seeing their advisors during course request week so as to assure appropriate curricula planning.

## Student Responsibilities: Satisfactory Progress Towards Degree

It is the student's responsibility to satisfy all course requirements as established by the faculty teaching the courses in which s/he is enrolled. It is also the student's responsibility to be aware of all major, degree, college, and graduation requirements necessary to complete his or her degree. Students are also responsible for satisfying all university, college, and departmental requirements for progress towards degree. (Consult "Checksheets" at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for major requirements.)

## Student Success Center

[www.studentsuccess.vt.edu](http://www.studentsuccess.vt.edu)

(540) 231-5499

The Student Success Center supports undergraduate learning from enrollment to degree completion by offering programs and services that help students become effective, self-motivated learners. The department offers free academic support, such as academic coaching, tutoring, and study skills seminars to undergraduates. Programs and activities for students who are already succeeding academically, and simply want to enrich their educational experiences at Virginia Tech are also available. All of programs and services are free to Virginia Tech students. The main office is located on the first floor of Femoyer Hall where we also

have a classroom, conference room, tutoring space and staff offices. Additional staff offices are located on other floors in Femoyer.

## Teacher Education

[www.soe.vt.edu](http://www.soe.vt.edu)  
[edinfo@vt.edu](mailto:edinfo@vt.edu)

Virginia Tech's School of Education offers programs leading to licensure in 17 fields of study. All educator preparation programs are at the graduate level. Students seeking a teaching or other educational license should consult the School of Education Office of Academic Programs website (<http://www.oap.soe.vt.edu>) for details on specific programs of interest.

The School of Education is accredited by the National Council for Accreditation of Teacher Education, and all programs are approved by the Virginia Board of Education. Graduates qualify for an educational license or endorsement in other states.

Undergraduate students who anticipate applying for a master's degree in education should consult an advisor in the Office of Academic Programs (OAP) ([edinfo@vt.edu](mailto:edinfo@vt.edu)) or the academic advisor in their undergraduate major. The OAP includes a Pre-Education Advisor as a resource for all undergraduates considering entering a career in education. Decisions about entering graduate programs in education should be made early in the undergraduate years so that an appropriate major can be selected and required courses can be taken prior to applying for the graduate program. Seniors with a GPA of 3.0 or better may apply to be admitted to the Dual Student Status for their last semester to take graduate-level education courses. Juniors with a GPA of 3.3 or better may apply for admission in the Accelerated Undergraduate/Graduate Degree Program to take graduate courses during the senior year. Information about these programs is available on the Graduate School website ([www.graduateschool.vt.edu](http://www.graduateschool.vt.edu))

Applicants for teacher education programs must submit passing scores on Praxis Core Academic Skills for Educators, or acceptable scores on the SAT or ACT prior to acceptance into the School of Education. Passing scores on relevant Praxis Subject Assessments, the Virginia Communication and Literacy Assessment, and the Reading for Virginia Educators exam (for elementary education teachers) are required prior to receiving a teaching license and prior to admission for some programs. A criminal record check is required by school divisions in Virginia prior to employment.

Notable features of the teacher education program at Virginia Tech are:

- graduates with a commitment to learning and advocacy for all students
- a faculty devoted to improving education through research, teaching, and outreach
- an emphasis on science, math, and technology within a comprehensive School of Education
- graduates with expertise in content fields and related pedagogical knowledge and skills
- committed clinical supervisors in schools
- field experiences and internships in diverse school settings
- the latest instructional technologies
- a strong demand for our graduates

Applications for School of Education programs may be submitted on line through the Graduate School website: [www.graduateschool.vt.edu](http://www.graduateschool.vt.edu).

## Undergraduate Courses of Study

Undergraduate courses of study leading to bachelor's degrees at Virginia Tech are listed below. In addition, many options and specialties pertaining to each academic college are described in the individual [college sections](#) in this catalog.

**College of Architecture and Urban Studies**

Architecture  
Art  
Building Construction  
Environmental Policy and Planning  
Industrial Design  
Interior Design  
Landscape Architecture  
Public and Urban Affairs  
Real Estate

**College of Agriculture and Life Sciences**

Agribusiness  
Agricultural Sciences  
Agricultural Technology  
Animal and Poultry Sciences  
Applied Economic Management  
Biochemistry  
Crop and Soil Environmental Sciences  
Dairy Science  
Environmental Horticulture  
Environmental Science  
Food Science and Technology  
Human Nutrition, Foods, and Exercise  
Landscape Contracting

**College of Engineering**

Aerospace Engineering  
Biological Systems Engineering  
Chemical Engineering  
Civil and Environmental Engineering  
Computer Engineering  
Computer Science  
Construction Engineering and Management  
Electrical Engineering  
Engineering Science and Mechanics  
Industrial and Systems Engineering  
Materials Science and Engineering  
Mechanical Engineering  
Mining Engineering  
Ocean Engineering

**College of Liberal Arts and Human Sciences**

Apparel, Housing, and Resource Management  
Classical Studies  
Communication Studies  
Consumer Studies  
Criminology  
Creative Writing  
English  
Family and Consumer Sciences  
Fashion Merchandising and Design  
French  
German  
History

Human Development  
Humanities, Science, and Environment  
International Studies  
Literature and Language  
Multimedia Journalism  
Music  
Philosophy  
Political Science  
Property Management  
Public Relations  
Professional and Technical Writing  
Religion & Culture  
Residential Environments & Design  
Russian  
Sociology  
Spanish  
Theatre Arts

**Pamplin College of Business**

Accounting and Information Systems  
Business Information Technology  
Economics  
Finance  
Hospitality and Tourism Management  
Management  
Marketing Management

**College of Natural Resources and Environment**

Environmental Resources Management  
Environmental Informatics  
Fish Conservation  
Forestry  
Geography  
Meteorology  
Natural Resources Conservation  
Packaging Systems and Design  
Sustainable Biomaterials  
Water: Resources, Policy, and Management  
Wildlife Conservation

**College of Science**

Biochemistry  
Biological Sciences  
Chemistry  
Computational Modeling and Data Analytics  
Economics  
Geosciences  
Mathematics  
Microbiology  
Nanoscience  
Neuroscience  
Physics  
Psychology  
Statistics

# University Enrollment and Academic Progress

## Registration Procedures

1. Registration for continuing students is an eight-day period (Course Request) in the middle of each semester during which currently enrolled students may request classes for the next semester. Students register for summer school (if they plan to attend) beginning in December. Students register for Fall semester during Spring semester.
  - a. Students should consult their completed Pathways Planner and review with his/her departmental advisor. Both should be aware of such considerations as the student's current GPA, the course load in hours and in effort required, pre- and co-requisites for courses so limited, the student's relationship to the eligibility schedule, and fulfillment of College and General Education (Curriculum for Liberal Education) requirements and those for major, minor, or cognate. If the student fails to meet with his/her advisor, a **hold** may be placed on their registration.
  - b. When a schedule is designed, the student enters the course requests by accessing [Hokie SPA](#).
  - c. Prerequisite checking is enforced by some departments. The registration system will review the student's academic history to determine compliance with any prerequisites.
  - d. **Overloads** (more than 19 hours per semester, 7 each summer session, or 6 for winter session) require permission of the student's academic dean. The student will be scheduled for the first available 19 hours (7 in Summer and 6 in Winter) requested.
  - e. Every student must annually provide an up-to-date local address, an emergency contact, opt in/opt out of the VT Alerts system and all students must acknowledge the University Policy on Student Life. Students are prohibited from registration until the requirements are updated in the student record system.
  - f. The student's **current class schedule** may be printed by accessing Hokie SPA; the student is then responsible for verifying that he/she is in fact enrolled in the courses and sections he/she has been attending.
2. Approximately three weeks after the close of registration week, course request results are available and may be accessed through Hokie SPA. The web class ticket will include detailed information regarding sections which are full, conflicting, withdrawn, or restricted which explains why these sections were not added to the student's schedule. See item number six (6) below for details about why a student's course selections are sometimes ignored, or why a student's schedule might be purged or held from registration.
3. Students may adjust their schedules on a space available basis using web DROPADD, an electronic schedule adjustment program. Students should consult with their advisors before making any changes except those for convenience (usually time). 1000-level Mathematics and English courses, because of the high demand, currently have restrictions on section changes. As a rule, any student who drops a 1000-level English or Math course via Hokie SPA or department will not be allowed to force-add another 1000-level English or Math course that term. A student should be aware that dropping below full-time status (12 semester hours) may jeopardize financial aid, campus housing, and degree completion. Some courses may drop students if not attending the first class. Refer to the comments section of the course in the *Time Table of Classes*.
4. A **Force-Add** form permits admission to a class **over** the desired enrollment threshold, but not over room capacity. This request is submitted via a "force-add" form **available in the department offering the course**, and requires the instructor's (or, in some departments, departmental) permission. **Requests for force-adds are processed by the department offering the course. Caution: The force-add transaction permits enrollment in courses with conflicting times.**
5. Responsibility for **Payment of Tuition and Fees**: all students who initiate enrollment either by course request or by dropadd are responsible for the payment of assessed tuition and fees. Only the

submission of an official withdrawal or resignation removes the student from any fee responsibility.

Failure to attend class(es) or to submit appropriate university paperwork is not a justifiable reason for removal of assessed fees retroactively.

6. **Late Adds and Drops Adjustments** to a student's schedule after the last date to carry out a specific transaction (see Hokie SPA for deadline dates) require permission of his/her own academic dean. Thus, a Business major wishing to late-drop an English course requires approval from the College of Business, not that of Liberal Arts and Human Sciences. A late-drop request based on mental or physical illness requires a recommendation from Schiffert Health Center and/or Cook Counseling Center. Faculty cannot add or drop students from their rolls.
7. **Purged and Held Registrations** Failure to pay tuition bills by a posted deadline (usually by the end of the 2nd week of classes) may result in the student's schedule being **purged** (removed from the system). A schedule may be **held** (made inaccessible to department staff, as well as to students using DROPADD, thereby precluding transactions of any type) for nonpayment of fees other than tuition (e.g., parking tickets), for Honor Code violations, for academic ineligibility (due to department and/or academic suspension), or for failure to make progress toward a degree. This last hold is imposed by the student's dean, while all other holds are imposed by other offices. The student should check with the office imposing the hold, as only that office is authorized to remove the hold. **The Office of the University Bursar processes all billing for tuition and fees; contact the Office of the Bursar if you have questions about your bill or do not receive a bill.**



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## University Policies Governing Enrollment

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## Appeals

Under extenuating circumstances, the student's academic dean may present, on behalf of the student, appeals for re-admission and other exceptions to academic eligibility policies to the Virginia Tech Academic Appeals Committee. Students presenting appeals based on medical reasons must request recommendations from the Student Health Evaluation Committee. Students may appeal other academic decisions made by their college associate dean to the college dean.

## Auditing Courses

A student may enroll as an auditor in any class other than laboratory classes and studio courses, with the permission of both their academic advisor and the class instructor. The lecture portion of laboratory-linked courses and courses with computation periods may be designated as eligible for audit at the request of the academic department head (of the course in question) and on the approval of the student's academic dean. Auditors may not add or drop an audit option after the last day to enter classes. Students will not be allowed to register for credit in any course previously audited. Students may not unofficially attend class(es).

## Class Level

A student must have received credit for at least 30 hours to be classified as a sophomore, at least 60 hours to be classified as a junior, and at least 90 hours to be classified as a senior.

## Course Prerequisites (University Policy)

Many course offering departments enforce prerequisite checking at registration. The automated system checks the student's academic history and/or current enrollment for verification of compliance. Students without the required prerequisite will be prohibited from enrolling. On occasion, students are permitted to take courses without having the specified prerequisites only upon obtaining the consent of the instructor. Students who enroll in a course for which they clearly have not satisfied the prerequisites or equivalent or obtained the appropriate permission may be dropped from the course. Deliberately false statements testifying to the satisfaction of prerequisites constitute a violation of the honor code. Students have the right to appeal a decision about prerequisites to the head of the department offering a course. Students should recognize that 3000 and 4000 level courses assume a certain level of academic maturity and general background regardless of the stated prerequisites. The course instructor can be consulted regarding the implications of this expectation for a specific course.

## Enrollment (Semester Hour)

Minimum full-time enrollment for undergraduate and associate degree students is 12 hours per semester in regular A-F option or P/F option. For each summer session, the minimum is 5 hours. Audit hours are not used in establishing minimum full-time enrollments.

**Full-time enrollment for graduate students is 9 hours or more in regular A-F option, P/F option, or equivalent credit. For each summer term, the minimum is 3 hours.** Neither the payment of full fees nor compliance with maximums established as a condition of employment or appointment is a basis for deviation from the definition above.

## Graduation with Distinction

Graduating with distinction is an honor bestowed on those who earn a 3.4 or higher and who complete no less than 60 hours at Virginia Tech. Distinction is denoted on the diploma and on the transcript. Levels of distinction are:

- Students with a cumulative GPA of 3.8 or greater are graduated ***Summa Cum Laude***.
- Students with a cumulative GPA of 3.6-3.7999 are graduated ***Magna Cum Laude***.
- Students with a cumulative GPA of 3.4-3.5999 are graduated ***Cum Laude***.

Grade Point Averages are not rounded in qualifying a student for distinction. In computing eligibility for graduation with distinction, only undergraduate level work attempted at Virginia Tech will be used. Students may not use hours earned at Virginia Tech as an associate, professional, or graduate level as part of the 60 semester hours required to earn distinction. The notation of distinction on the diploma and on the transcript is independent of the notation of a degree in honors, if applicable. (See section on "[The Honors Program](#)" for information about graduating *in honors*.)

## Limits on Acceptable Credits for Degrees

Not more than 6 credit hours earned from extension courses, radio courses, television courses, and intensive courses (e.g. taken while in active military service, etc.) will be accepted for undergraduate degree credit. Thirty-eight hours of advanced placement credit and/or international baccalaureate and/or Cambridge International Examination credit may be accepted towards the undergraduate degree.



# Readmission through University Registrar or Academic Dean

Formerly enrolled students who have greater than the 2.0 GPA overall may seek readmission via web course request form if they are eligible to return. Students returning from academic suspension should consult their academic dean's office for readmission procedures. (These procedures vary from college to college within the university.)

Formerly enrolled students, not in good academic standing who stop enrollment or resign for personal reasons, and later complete course work at another college or university are required to submit their transfer transcripts to certify good standing at all institutions.

Academic standing and student conduct at other institutions are considered in the deliberation for approval for readmission.

Formerly enrolled students in good academic standing who resign for personal reasons, do not continue enrollment at Virginia Tech, and later complete course work at another college or university are required to submit their transfer transcripts to their academic dean prior to or during their first term of re-enrollment.

## Registration Requirements

**Demographic Information:** Virginia Tech policy requires annually the collection of specific demographic data for each student: emergency contact entry or emergency contact confirmation, and VT alerts Opt In or Opt Out action.

**Local Mailing Address:** Virginia Tech policy requires the updating of a student's local mailing address to reflect the local residential address while enrolled in school.

**Conduct Policy:** Students must annually acknowledge the Virginia Tech's Student Conduct policy on Arrests and Convictions. The University enacted policy requiring all students, regardless of academic level or campus, to report any arrests, convictions, and/or protective orders to the university.

**VT Alerts:** Students must opt in or opt out of the Virginia Tech alert system annually.

Students will be prohibited from registration until the above information is provided.

**Missing Person Contact:** Student(s) may denote a specific third party as emergency contact as primary in cases of missing person(s). Visit Hokie SPA, choose the Hokie Plus menu, add 'new emergency contact'. In the pull down selection for relationships, choose « Missing Persons Contact ». In the case of such an emergency, the university will first contact the missing person designee before any alternate emergency contact(s).

## Resignations

A student may resign without academic penalty by completing an official Virginia Tech resignation form on or before the published resignation deadline for each term. The student can request this resignation form from either the University Registrar's Office, the University Registrar's website, or the academic Dean's Office. The student's grade report and permanent record will show that he/she was enrolled for the term and that he/she resigned on the specific effective date.

A student who resigns after the stated deadline without written authorization for resignation-without-penalty by the respective academic dean will receive automatic "F" grades in all courses in which the student is enrolled. The transcript will carry the notation, "Suspended by committee action for unauthorized resignation," and the hours for which "F" grades were received will be included in the cumulative GPA for both academic eligibility and graduation requirements.

In the case of authorized resignations after the deadline, grades will not be assigned, and the academic dean

will determine the student's academic status (whether or not he/she is eligible to return) based on the student's previous record.

## Satisfactory Progress

University policy requires that all students meet the following minimum criteria to be certified as making satisfactory progress toward a degree.

- Have an overall grade point average at or above that specified in the academic eligibility schedule (determined at the end of the Spring semester).
- Upon having attempted 36 semester credits (including transfer, advanced placement, advanced standing, credit by examination, and freshman rule hours), students must have passed at least 12 semester credits of Curriculum for Liberal Education requirements.
- Upon having attempted 72 semester credits (including transfer, advanced placement, advanced standing, credit by examination, freshman rule hours), students must:
  - have passed at least 24 semester credits of Curriculum for Liberal Education requirements
  - be enrolled in a degree-granting program and
  - be certified at the close of the academic year by their department as making satisfactory progress toward a degree, based upon pre-established minimum criteria from departmental checksheets.
- Upon having attempted 96 semester credits (including transfer, advanced placement, advanced standing, credit by examination, and freshman rule hours), students must have an in-major grade point average of 2.0 or above.

Colleges and departments may impose additional requirements. It is the student's responsibility to become familiar with the requirements of his or her college.

## Transfer Work while on Suspension

A student may not receive credit for course work taken at another college or university during any period in which the student has been placed on suspension by Virginia Tech for academic or disciplinary reasons.

## Undergraduate taking Graduate Courses

Undergraduate students may enroll in graduate-level course work in the senior year, provided they have an overall GPA of 3.0 or above and the written approval of the department head and the Graduate School. To enroll in graduate-level course work, the undergraduate student must apply to the Graduate School as a dual registrant. Each term that a student is dually enrolled, he or she must fill out a form in the University Registrar's Office to indicate which courses are being counted for undergraduate credit and which for graduate credit. If graduate courses are used to satisfy undergraduate degree requirements, they cannot be used to satisfy any advanced degree requirements at Virginia Tech. Students may not concurrently have dual status while enrolled in an Undergraduate Dual status.

Graduate courses may not be taken without prior written approval from the Graduate School.

### **Accelerated Undergraduate/Graduate Degree status**

High achieving and talented seniors may apply for Accelerated status. The minimum admission requirements are:

- An advisor for the proposed accelerated program
- Listing of courses for use on the plan of study
- Minimum grade point average of 3.3
- Some programs may include additional requirements

The Accelerated Undergraduate/Graduate Degree status allows students with specific qualifications to allow

certain courses to count toward both the undergraduate and graduate degree:

- No more than twelve (12) credit hours may be used.
- All courses must be at the 4000 level or higher.
- No more than six (6) credit hours may be used at the 4000 level.
- A grade of B or higher must be earned in each course. No courses may be taken pass/fail.

## 125 Percent Rule for In-State Tuition

The Code of Virginia establishes rules for eligibility for in-state tuition for all students enrolled at public institutions in the Commonwealth of Virginia. Section 23-7.4:F of the Code of Virginia further requires undergraduate students to maintain progress toward the degree to comply with continued eligibility for in-state tuition. Students with entry dates Fall 2006 and after may not exceed attempted hours that total 125% of the minimum credit hours needed for a specific degree program and retain in-state tuition eligibility. Students exceeding 125% will be assessed a surcharge for each semester of continued enrollment after exceeding the credit hour threshold. For the purpose of this state law, all credits attempted (Virginia Tech and Transfer) are used in the calculation of the percentage. The requirement does allow the subtraction of credits awarded for Advanced Placement, Advanced Standing, International Baccalaureate, and Credit by Exam from the attempted totals. Important resources to assist you so as to avoid the credit hour surcharge are:

- Undergraduate Degree Hours and 125% Tuition Credit Hour Threshold Table ([http://www.registrar.vt.edu/academic\\_records/in-state/125-percent-table.html](http://www.registrar.vt.edu/academic_records/in-state/125-percent-table.html))
- Credit Hour Surcharge Costs, Virginia Tech Bursar (<http://www.bursar.vt.edu/tuition>)  
Click on "surcharge" link. Please note that the Excess Credit Hour Tuition surcharge is per credit hour. To calculate the total surcharge for a term, multiply the surcharge amount per credit hour by the number of credit hours enrolled (up to 12 credit hours per semester; 5 credit hours per summer term).
- [State Code of Virginia, Section 23-7.4:F](#)

Students with declared second majors and minors: the total credits additional required for earning of the second degree and/or minor will be added to the total prior to computing the 125 percentage. For example, as student's first degree requires 120 hours. The second degree requires 30 additional hours. The 125% will be computed based on 150 hours.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Family Educational Rights and Privacy Act of 1974 (FERPA)

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[Family Educational Rights and Privacy Act of 1974](#)

[FERPA Disclosure](#)

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## Family Educational Rights and Privacy Act of 1974

### Annual Notification of FERPA Rights

To comply with the provisions of the Family Educational Rights and Privacy Act of 1974 (as amended), Virginia Polytechnic Institute and State University will not release education records or personally identifiable information contained therein, other than directory information, without the student's written consent.

Directory information at Virginia Polytechnic Institute and State University includes:

- Student's Name
- Local and Permanent Address(es)
- Telephone Number(s)
- VT Email Address
- Major Field of Study (Including Second Majors, Minors, etc.)
- Whether a Student is Currently Enrolled
- Enrollment Status (Full-time, Half-time, etc.)
- Class (Freshman, Sophomore, etc.)
- Academic Level (Associate, Undergraduate, Graduate, Professional)
- Anticipated Date of Graduation
- Certification of Application for Degree
- Dates of Enrollment
- Degree(s) Earned (Including Date, Honors and Level of Distinction)
- Participation in Officially Recognized Activities and Sports
- Weight and Height of Members of Athletic Teams
- Electronic Theses and Dissertations (ETD)

Directory information will be withheld upon the written request of the student. Such prohibition against release generally does not extend to record requests from other school officials at this institution who have an educational need to know, state and federal education authorities, courts or accrediting organizations. Questions concerning this policy may be referred to the Office of the University Registrar.

## FERPA Disclosure

Due to the laws covering confidentiality, it is a violation of the regulations for anyone to release non-directory information (grades, course enrollment, class schedule, standing) about any student to anyone without permission from the student. The Family Educational Rights and Privacy Act (FERPA) requires the student to authorize the university prior to release of any academic record information to a third party. Completion of the online form (Hokie SPA) allows the student to approve disclosure of his/her academic record information to parent(s) and/or guardian(s) via an assigned "Pass Code". University officials must request the pass code prior to the release of any requested information. The disclosure will remain valid until the student removes the authorization.

Tax Dependent? The Commonwealth of Virginia requires Virginia's colleges and universities to release academic record information to parents of tax dependent students. This requirement is allowable within the guidelines of FERPA. If the student is a tax dependent of his/her parent or guardian, please denote that information by checking "YES" in the question column, "Are you a Tax Dependent?" on the online FERPA disclosure form (Hokie SPA). Students are informed of any release of information prior to disclosure.

## Notification of Rights Under FERPA

The Family Educational Rights and Privacy Act (FERPA) affords students certain rights with respect to their education records. These rights include the following:

1. The right to inspect and review the student's education records within 45 days of the day the University receives a request for access. Students must submit to the Office of the University Registrar written requests that identify the record(s) they wish to inspect. The university official will make arrangements for access and notify the student of the time and place where the records may be inspected. If the records are not maintained by the University official to whom the request was submitted, that official shall advise the student of the correct official to whom the request should be addressed.
2. The right to request the amendment of the student's education records that the student believes are inaccurate or misleading. They should write the University official responsible for the record, clearly identify the part of the record they want changed, and specify what is inaccurate or misleading. If the University decides not to amend the record as requested by the student, the University will notify the student of the decision and advise the student of his or her right to a hearing regarding the request for amendment. Additional information regarding the hearing procedures will be provided to the student when notified of the right to a hearing.
3. The right to consent to disclosures of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes disclosure without consent. One exception which permits disclosure without consent is disclosure to school officials with legitimate educational interests or concerns of health and safety. A school official is a person employed by the University in an administrative, supervisor, academic or research, or support staff position (such as health staff); a person or company with whom the university has contracted (such as an attorney, auditor, or collection agent); a person serving on the Board of Visitors; or a student serving on an official committee, such as a disciplinary or grievance committee, or assisting another school official in performing his or her tasks. A school official has a legitimate educational interest if the official needs to review an education record in order to fulfill his or her professional responsibility.
4. The right to file a complaint with the U.S. Department of Education concerning alleged failures by Virginia Tech to comply with the requirements of FERPA. The name and address of the office that administers FERPA is:

Family Policy Compliance Office  
U.S. Department of Education  
400 Maryland Avenue, SW  
Washington, DC 20202-5920  
<http://www.ed.gov/policy/gen/guid/fpco/ferpa/index.html>

Students may also file a complaint with the University Registrar:

Rick Sparks  
250 Student Services Building  
Blacksburg, Virginia 24061-0134  
(540) 231-7951

**The Family Educational Rights and Privacy Act** indicates that students and former students should be granted the opportunity to change their names on education records upon the production of evidence showing that the name has changed. The following procedure applies to requests for changes to the name appearing on a student's education record:

- Complete Request for Change in Name form in the Office of the University Registrar
- Provide a photocopy of a Social Security card that reflects the new name and a valid drivers license or other form of photo identification
- Provide a photocopy of a birth certificate, marriage certificate or license, divorce decree, court order, or naturalization papers including certificate number, petition number, and registration number

Please note that all documentation used in support of this request should reflect the name for which you are requesting the change.

**The Privacy Act of 1974 (U.S. Public Law 93-579, Sect. 7)** requires that the university notify students that disclosure of a Social Security number is voluntary unless employed by the university or receiving federal financial aid. Pursuant to the 2003 State Code of the Commonwealth of Virginia, no student identification card may display the social security number as an identifier. Effective with students entering Fall 2003 and beyond, a generated identification number will be utilized as the default unique identifier. This generated number will be nine digits in length and will begin with the number, "9", nine. The generated student identification is defined as personally identifiable information by federal legislation, FERPA (Family Educational Rights and Privacy Act) (U.S. Public Law 93-579, Sect. 7), and is prohibited from disclosure except to education officials with legitimate educational interest.

For students who entered Virginia Tech prior to Fall 2003, the social security number was the default student identification number. Effective with the entering class of Fall 2003, a nine digit generated identifier is assigned to each student. Use this identifier when the student identification number is requested by a university official. Important note: disclosure of the social security number may be required by different university offices if required by the Code of the Commonwealth of Virginia or Federal statute.

## Required Demographic Information

Virginia Tech policy requires annually the collection of specific demographic data for each student: local mailing address, emergency contact entry or emergency contact confirmation, VT Alerts Opt In or Opt Out action, and review of the Virginia Tech Student Conduct Policy. Students will be prohibited from registration until the information is provided.

## Missing Person Contact

Student(s) may denote a specific third party as emergency contact as primary in cases of missing person(s). Visit Hokie SPA, choose the Hokie Plus menu, add 'new emergency contact'. In the pull down selection for relationships, choose "Missing Persons Contact". In case of such an emergency, the University will first contact the missing person designee before any alternate emergency contact(s).



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Grades, Grade Points, and Credit Hours

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- [AP, IB, Cambridge Exam](#)
- [Credit by Examination](#)
- [Credit for ROTC Courses](#)
- [Credit Hour System](#)
- [Dean's List](#)
- [Examinations and Re-Examinations](#)
- [Grade Appeal Procedure](#)
- [Grades and Grade Points](#)
- [Grades \(Midterm\)](#)
- [Graduation Requirements \(Grade Hours Passed or Completed\)](#)
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## AP, IB, Cambridge Exam

Virginia Tech awards AP, IB, Cambridge Exam equivalencies after faculty review of content and applicable Virginia Tech credit. In accordance with state policy, Virginia Tech accepts credit from [Advanced Placement](#), [International Baccalaureate](#), and Cambridge Exam based on annual faculty and university program review.

## Credit by Examination

Credit, not to exceed 12 semester hours, may be allowed by special examination where exceptional command of a subject can be demonstrated in lieu of formal course work. This privilege is not available to a student who has previously audited or enrolled in the course, or has previously attempted credit by examination in the course. If credit by examination is deemed appropriate, the offering department shall have full responsibility for determining the type of examination to be given and what constitutes a passing grade.

Credit established by examination may not be used to satisfy the in-residence requirements for graduation. No

grades or quality credits will be assigned.

There is a per-credit fee for the examination. The current fee is \$10.00 per credit hour and is subject to change at the beginning of an academic year. Only currently enrolled undergraduate students are eligible for special examinations allowing university credit. Official approval must be obtained from the head of the department offering the course.

## Credit for ROTC Courses

In some majors, not all ROTC courses may be applied toward a bachelor's degree. Students should consult their approved major checksheet for specific information on which courses will count toward their degree.

## Credit Hour System

Virginia Tech uses the credit-hour as its unit of credit in the semester calendar system. Course descriptions under the departments of instruction (in the chapters on the various colleges) indicate the number of credits received per term.

## Dean's List

Undergraduate students who attempt at least 12 credit hours with all credits graded on the A-F option and who earn a 3.4 GPA for either spring or fall semester will be included on the Dean's List for that term. The Deans' Lists are not compiled for summer sessions. Any notifications or certificates indicating inclusion on the Dean's List for a particular term are issued by the student's academic dean.

## Examinations and Re-Examinations

Final examinations are held at the close of each term according to a schedule established by the university. An instructor may not change the date or time of a final exam without the approval of the dean of the college. Students may request permission from their college dean to reschedule a final exam if they have conflicting exams or if they have three final exams in 24 hours. Otherwise, permission to reschedule a final exam is granted by the dean only in very unusual circumstances. Deferred final exams may be authorized only by the student's academic dean or by the Schiffert Health Services.

Re-examination of one final exam is available only for students who are candidates for degree in the same term as the final exam.

After a term is over, a re-examination in one course in which the final grade earned is C- or below may be authorized if the student was enrolled in the course during the final term of his or her senior year and if a satisfactory re-examination in the course will qualify the student for graduation. The student must make the re-examination request to the dean and must complete the exam as soon as possible after the first examination.

For the student to be granted a re-examination, approval is required by the instructor, the student's department head, and the student's academic dean. In determining the validity of the student's request, consideration is given to class performance and completion of assigned work. The University Registrar provides verification of compliance with the requirements of this policy.

## Grade Appeal Procedure

As Per University policy, the assignment of a grade is the sole prerogative of the instructor of the class. It is incumbent on the instructor to establish the criteria for grading in the syllabus that is distributed at the beginning of the term. All grades are to be based on established grading criteria and not on personal conduct or opinions unrelated to academic standards. An individual student may not do extra work to raise his/her grade. If a student feels that a grade has been calculated incorrectly or has been assigned in a prejudiced or capricious manner, the student should discuss the matter with the instructor. If discussion between the



instructor and the student cannot resolve the issue, the student should appeal to the department/division head. In the unusual circumstance that resolution does not occur at the departmental/divisional level, the student may appeal to the college dean who will attempt to reconcile the matter by whatever mechanism seems most appropriate for that college and for that case. A grade appeal must be made by the student as soon as possible but no later than the end of the student's subsequent term of enrollment after the grade in question has been assigned.

## Grades and Grade Points

The academic achievement of a student in a specific course is rated as follows:

Letter Grade	Grade Points for each hour	
A (Excellent)	4.0	<ul style="list-style-type: none"> <li>A grade of "I" (incomplete) may be given when the requirements of a course other than the final examination have not been completed due to illness or extenuating circumstances beyond the student's control. The "I" grade is the prerogative of the instructor.</li> <li>To remove an "I" grade, lecture course requirements must be satisfied during the student's first subsequent term of enrollment, and laboratory course requirements must be satisfied prior to the end of the first term during which the course is offered and the student is enrolled. Incomplete and "X" grades are automatically converted to "F" if requirements are not fully satisfied during the period of time allowed.</li> <li>An "NR" grade is assigned automatically by the system when a student is enrolled for a class and no other grade is assigned by the instructor. The "NG" is intended to be a grade distinguishable from those initially assigned by the instructor and thus to indicate clearly the origin of the grade.</li> <li>"W" Grade: Courses from which a student withdraws under the terms of the policy, will appear on their transcript with a "W" grade, but will not count in the GPA hours nor in any GPA calculations. The "W" signifies that this policy was invoked and does not reflect the rationale for its use. The reasons for use remain the student's purview.</li> <li>Grade Point Average (GPA) is computed by dividing the total number of quality credits earned by the total number of hours attempted at Virginia Tech, except courses passed on a Pass/Fail basis and courses with an "X" (Continuing Course). "NG" grades are computed as "F" grades in determining GPA. The GPA is unaffected by the "I" grade, unless or until the "I" is converted to an "F" for failure to complete the course requirements within the allotted time. All courses repeated count in the calculation of the grade point average unless changed to Pass/Fail per policy.</li> <li>Repeated Courses: A student may not repeat courses in order to improve his or her grade average where a grade of "C" or higher has been earned. An assigned grade of "A-D" for the second occurrence will be changed to a grade of "P" whenever a graduation analysis (DARS report) detects a repeated course with a "C" or better grade. Repeating a course where the course is "C-" or below, both instances of the graded course will be computed in the grade point average.</li> </ul>
A-	3.7	
B+	3.3	
B (Good)	3.0	
B-	2.7	
C+	2.3	
C (Fair)	2.0	
C-	1.7	
D+	1.3	
D	1.0	
D- (Barely Passing)	0.7	
F (Failure)	0.0	
I (Incomplete)	---	
NG (No Grade)	---	
NR (Not Reported)	---	
P (Passing)	---	
RP (Repeated Course)	---	
S (Satisfactory/credits only)	---	
W (Course Withdrawn)	---	
X (Continuing Course)	---	

## Grades (Midterm)

Midterm grades are produced for freshmen and transfer students whose first term of enrollment is fall semester. Beginning Fall 1996, students whose first term of enrollment is summer will also receive a midterm grade report during fall semester. "Satisfactory" is given for work earning a grade of C or better and "unsatisfactory" is given for work earning a grade of C- or below. The midterm grade is not part of the student's permanent academic record and is only intended to be an early indication of the student's progress.

## Graduation Requirements (Grade Hours Passed or Completed)

The "total credits" figure on the displayed grade report is not necessarily the same as the total hours (often referenced as hours passed) required for completion of the degree (not all credit hours are effective toward graduation requirements). Students are responsible for verifying required hours for completion by reviewing their degree analysis (DARS) with their advisor.

Listed below are a few examples of typical situations yielding "pass" hours which must be subtracted to determine the total credits useful toward graduation requirements:

- Transfer and/or advanced placement credits that have been subsequently duplicated by courses at Virginia Tech.
- Credits earned at Virginia Tech that have been duplicated by repeating courses or taking courses ruled to have duplicating credit.
- Transfer credits allowed from a two-year college that are in excess of one-half of the total credit hour requirement for the curriculum.
- Credits for **Physical Education Service Activities** courses (now listed under HNFE), which exceed a total of two, the maximum allowed toward a bachelor's degree.
- Credits for military science that exceed the total specified by the college for the student's curriculum.
- Credits on the pass/fail grading system that exceed 12 credit hours allowable exclusive of pass/fail only courses.
- Credits for courses that do not count towards the degree, (e.g. UNIV 1004 College Success Strategies)..

## Obsolete Academic Records

Under the "Obsolete Academic Records Policy," former Virginia Tech students returning to the university after an absence of at least five years may request in writing to have their academic records evaluated by the appropriate academic dean. Such transcripts will be evaluated in the same manner that transfer student transcripts are considered; credits will be allowed only for those courses appropriate for the degree. The grades for these allowable courses will not be factored into the student's GPA, but all courses will remain part of the student's permanent record.

## Pass/Fail Grading System

A limited pass/fail (P/F) grading system is available to encourage students to enrich their academic programs and explore more challenging courses outside their majors, without the pressures and demands of the regular grading system. The P/F grading option is available to all undergraduates who have completed a minimum of 30 credit hours at Virginia Tech and have a cumulative GPA of 2.0 or above. These restrictions do not apply to courses that are only offered P/F. **No required course or course used for the Curriculum for Liberal Education may be taken on a "P/F" basis (unless only offered on a P/F basis).**

Under the pass/fail system students are allowed to attempt twelve (12) credit hours in their degree program on a pass/fail basis exclusive of courses only offered pass/fail. Students enrolled in five-year designated

programs (College of Architecture and Urban Studies) may attempt twelve (12) credit hours or ten percent of the total hours required for the degree whichever is greater. Courses offered pass/fail only are not included in the twelve total hours allowable under the pass/fail system. Additional degree programs may not be used to increase the number of pass/fail credits that a student is permitted to use toward any degree. No more than two courses per term may be taken P/F, excluding physical education activity courses and required courses offered on a P/F basis only.

Under the P/F grading system, a "P" is granted for earning a "D" or better in the course; otherwise, an "F" is given. A "D-" is a failing grade under the P/F option. The "P" or "F" is recorded on the student's transcript and credit is given if the course is passed. If the course is failed, the "F" is considered equivalent to an "F" received under the "A-F" grading system and is included in calculation of the grade point average (GPA). Once credit is received for a course taken under the P/F system, the course cannot be repeated under the "A-F" grading system.

**Any course to be taken under the P/F option should be designated as such upon request for the course.** The student may change grading options to P/F until the drop deadline and to A-F until the deadline for resigning without penalty.

## Repeat Course Policy

Beginning Fall 2016 students may only attempt to repeat a course three times. An "attempt" is when a student is enrolled in a course on the last day to add courses during each semester. Courses designated as repeatable credit (to the limit allowed) are excluded from this policy (e.g. independent studies, internships, etc.).

All course repeats should be done in consultation with a student's academic advisor. Any student who enrolls for a fourth attempt will be dropped from the course. If a student's extenuating circumstances prevent successful completion of the course on a third attempt, the student may appeal (petition) to repeat the course again. For more information regarding the appeals process, please refer to your academic dean's office.

Repeating a course subsequent times may affect financial aid and eligibility for certain programs. Students receiving financial aid should check with University Scholarships and Financial Aid to determine what, if any, financial aid implications there are for repeating courses. Veterans, athletes and international students may have additional rules associated with course repeats. Check with the appropriate department for additional information.

## Study Week

Study week refers to the last three calendar days of classes for each semester. All written work, with the exceptions noted below, should be assigned so that it can be graded and returned during a regularly scheduled class meeting of the term. In-class hour-long examinations or other major in-class written assignments or tests shall not be given during study week. The exceptions for undergraduate courses are:

- Dates for turning in term papers and project reports may be set at the discretion of the instructor, provided that the student is not to be held responsible on the final examination for the subject matter therein.
- In laboratory courses or other courses that do not warrant a final examination during the examination period, an examination, if required by the department and/or instructor, may be given during the last regularly scheduled laboratory or class period.
- Regularly scheduled final examinations, when special permission has been granted by the dean of the appropriate college.

Graduate courses also have specific exceptions which may differ from those for undergraduate courses. Contact the Graduate School for details.

## Transfer Credits

Enrolled students in good standing at Virginia Tech must receive pre-approval from their academic dean's office to transfer credit to Virginia Tech. Pre-approval from the academic dean does not guarantee transfer of the course if the student has duplicate credit in the approved course. Students must review their degree requirements (viewing DARS) to assure credits are degree applicable. Students who have been placed on academic or judicial suspension by the University are not eligible to transfer credit for terms of enrollment that coincide with their suspension term(s).

The rules below govern the transfer of credit on a university level. Some colleges at Virginia Tech have additional policies and procedures regarding transfer credit. Students are responsible for consulting with the academic dean's office in the appropriate college to discuss their plans to transfer credit, and to request information on the college's specific policies and procedures regarding transfer.

- Courses for transfer must be taken at an accredited college or university.
- Courses must be college-parallel, not terminal courses in a vocational program.
- Only courses with a "C" grade or better will transfer. Note: A "C-" will **not** transfer.
- Credits will **not** transfer for students who are classified as non-degree-seeking students.
- Course equivalencies will be determined by the Office of the University Registrar.
- Credit hours transfer; grades do not transfer.
- No more than 60 (sixty) semester hours may transfer from the Virginia Community College System (VCCS).
- Of the last 45 semester hours before graduation, a maximum of 18 semester hours may be transfer hours.
- Many colleges and universities will require a letter of good standing from Virginia Tech before they will enroll a student from another university who wishes to transfer credits back. Virginia Tech students can request this letter certifying their good standing by completing a "Request for Certification" form in the Office of the University Registrar.
- Upon completion of the course(s) and posting of grades, students are responsible for requesting that an official transcript be sent directly to the Office of the University Registrar at Virginia Tech as soon as possible, but not later than two semesters after the work is completed.

## "W" Grade Policy

The policy is intended to assist undergraduate students who find themselves enrolled in undergraduate level courses for which they are insufficiently prepared, or for those who initially enroll in majors that they subsequently change. This policy allows currently enrolled students to designate a grading option of "CW" to a course. Courses with this option are not gradable but remain on the academic transcript with the letter grade of "W". A maximum of three (3) courses (regardless of credit) may be dropped beyond the normal six-week drop deadline date during a student's undergraduate academic career at Virginia Tech subject to the following stipulations:

- Students must formally request to apply the W Grade option to a course by the last day of classes of each term. The deadline appears in the deadlines listing of the online *Time Table of Classes*.
- Courses with the new grade mode of "W" will appear on the transcript with a "W" grade, but will not count in the GPA hours nor in any GPA calculations. The "W" signifies that this policy was invoked and does not reflect the rationale for its use. The reasons for use remains the student's purview.
- There are no refunds of tuition and fees as a result of application of the policy. However, utilization of this grade option policy may affect Reasonable Academic Policy requirements for continued receipt of federal financial aid. Students are urged to consult with their financial aid advisor.
- A student decision to invoke this policy is irrevocable and unappealable.
- Application of the W grade option may not be employed to reduce or obviate any penalty otherwise accruing to students under the University Honor System. Previously processed W grade options will be voided if the course is penalized per an Honor System action.

- Students may request a W grade option change for any course, irrespective of the evaluation earned in it up to the point of their request for withdrawal. However, if a registration hold exists at the time of application of this policy, the student must take action to remove the hold within five (5) working days of the application or the request will be voided. Students are responsible for resolving their registration holds with the appropriate university office.
- Students already enrolled when this policy takes effect who have exercised their option to use the previously existing Freshman Rule shall not be eligible to use this policy.

To exercise this option, interested students should see their academic advisor to obtain a course withdrawal form and submit it to their designated departmental representative and academic dean for approval.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Admissions Information

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- 

## Academic Credentials

Academic preparation for Virginia Tech is best achieved by continued formal study of academic or college preparatory subjects. Consequently, it is recommended that required and elective academic units be evenly distributed throughout the high school years. Specifically, it is recommended that a minimum of seven (7) academic units be completed during the last two years of high school with at least three (3) academic units completed each year in the most rigorous academic programs available.

Each application is evaluated holistically. Primary criteria are: rigor of academic program, grades in academic courses, and standardized test (SAT or ACT) performance. Other criteria include alumni of Virginia Tech pipeline or TRiO program participation, special talents, first-generation college attendee, interest in the Virginia Tech Corps of Cadets, legacy, leadership and service, major, ethnicity, residency, disciplinary record, and

responses to personal statements and (optional) guidance counselor reference. (While letters of recommendation are not required, if an applicant chooses to send one letter of recommendation, it must accompany the high school transcript.) For the 2013 fall semester, those offered admission had a middle 50th percentile of GPAs of 3.78-4.23) and a middle 50th percentile of combined SATs (critical reading and math) of 1160-1340. Competitive freshman applicants will have A/B grades in a rigorous curriculum and strong SAT or ACT scores. Students who opt to take only the ACT also should take the ACT writing test.

Students who intend to compete in intercollegiate athletics are also required to meet all NCAA and ACC requirements for admission.

Prospective music students must schedule an audition with the music department. Applicants who wish to request an audition should contact the department head by January 1 of the senior year in high school.

## Admission (Undergraduate)

Prospective students and their families are welcome to visit the campus any time the university is in session. The Office of Undergraduate Admissions is open Monday-Friday from 8:00 a.m. to 5:00 p.m. and on many Saturdays from 8:30 a.m. to noon. Admission information sessions and student-led walking tours are offered regularly; reservations should be made in the 'Visit Virginia Tech' section at [www.admiss.vt.edu](http://www.admiss.vt.edu) for up-to-date schedule information. Virginia Tech neither requires nor schedules personal interviews for undergraduate admission.

Information on undergraduate admission may be obtained by contacting:

### Office of Undergraduate Admissions

Virginia Tech

Blacksburg VA 24061

**Phone:** 540-231-6267

**Fax:** 540-231-3242

**E-mail:** [admissions@vt.edu](mailto:admissions@vt.edu)

**Web:** <http://www.admiss.vt.edu>

## Admission (Freshman Process)

When applying for admission as a freshman, the applicant must send the following materials to the Office of Undergraduate Admissions prior to the deadlines:

1. Official application and application fee (non-refundable): \$60 for freshmen, transfer, and non-degree students; \$70 for international students.

**Please note:** *we expect students to apply online at [www.admiss.vt.edu](http://www.admiss.vt.edu).*

2. An official or unofficial copy of the secondary school record (transcript), including grades on all work through the junior year.
3. A list of the courses in which the applicant is, or will be, enrolled as a senior. The applicant's record through the first semester of the senior year is also reviewed in the freshman admissions process. Mid-year grade reports should be sent to the Office of Undergraduate Admissions as soon as available.
4. Official scores on the SAT or the ACT.
5. Students who are homeschooled or graduating from a non-accredited high school are encouraged to present either two SAT Subject Area test scores in math and a second area of study to be chosen by the applicant OR grades in two community college courses including one math course.
6. Discharge certificate (DD214) if the applicant is a veteran.

**NOTE:** Applicants are expected to create guest account access to their online status page to monitor receipt of required supplemental materials, as instructed by e-mail after submitting their applications.

An **Early Decision Option** is available for students with strong qualifications who are committed to attend Virginia Tech. Those interested in Early Decision must choose that option on the application form and submit all required credentials by November 1. All Early Decision applicants are notified of their admission status by December 15. Early Decision applicants may be offered admission, deferred to the regular applicant pool, or denied admission. (Students denied admission under Early Decision are no longer admissible to Virginia Tech and should not reapply for Regular Decision for the same term.) Applicants deferred to the regular decision pool will receive unbiased consideration during this admission process. Early Decision is a binding agreement in which applicants agree to apply only to Virginia Tech under an Early Decision option and, if offered admission, submit the matriculation deposit by January 15. This does not mean that Early Decision applicants cannot apply to other institutions as regular-decision applicants, but rather that Virginia Tech is their first choice and, if offered admission under Early Decision, they will withdraw applications to other institutions, and accept the Virginia Tech offer.

Freshman applicants applying for Regular Decision must submit a completed application by January 15 and will receive a notification of the admission decision by April 1. If offered admission, the applicant will receive an official offer letter, instructions to apply online for housing, and instructions to download the state-required health history form. Virginia Tech subscribes to the National Candidate's Reply Date of May 1 for freshmen offered admission for the fall semester.

## Admission (International Applicants)

International applicants for undergraduate admission are generally considered out-of-state students for tuition purposes and should apply using the Application for International Admission. International student applicants must meet all freshman or transfer requirements, as previously outlined. International freshman applicants must submit SAT or ACT scores. In addition, international students whose native language is not English must document proficiency in the English language by submitting a TOEFL (Test of English as a Foreign Language) score or IELTS (International English Language Testing System) score. Official copies of all scores must be submitted to the Office of Undergraduate Admissions.

The TOEFL or IELTS is required of all applicants who are not native speakers of English, in addition to all foreign students with visas, except those raised or schooled in Australia, Canada, Great Britain, Ireland, Jamaica, or other countries in which English is the language of instruction. A TOEFL score of at least 90 (with no subscore below 20) on the Internet-based test is expected. Students taking the IELTS are expected to obtain a score of at least 7.0 to be considered for admission to Virginia Tech. Achieving these scores is no guarantee of admission. Transfer applicants who have completed two semesters or terms of a non-ESL English composition course with above-average grades at an accredited U.S.-based college or university are not required to submit TOEFL or IELTS scores.

Non-English transcripts and documents must be submitted in their original form, accompanied by a certified English translation. Unofficial documents and documents without accompanying English translations will not be accepted.

International transfer students must submit a syllabus and course descriptions of all courses taken at the university level. This description of each course or subject studied (including textbook used and author) must be submitted in English or accompanied by a certified English translation of the syllabus. Applications without this information cannot be considered. All university-level work completed outside the United States must be evaluated by a professional educational credential evaluation service. (A listing of credential evaluators is linked on the online international application.) No financial aid is available for international students at the undergraduate level. All undergraduate international applicants must certify that they have sufficient funds to pay for their education at Virginia Tech prior to being issued an I-20 or IAP-66.

All international students holding F-1 and J-1 visas must purchase health and accident insurance.

The **Cranwell International Center** provides a full range of services to international students at Virginia Tech. Such services include an orientation program especially designed to meet the needs of new international students, as well as immigration counseling and counseling for personal and financial problems. The center also coordinates a variety of cross-cultural programs designed to facilitate interaction between American and



international students.

## Admission (Non-Degree-Seeking Students)

Virginia Tech makes every effort to provide educational opportunities to individuals who are not seeking a degree from the university, but who wish to continue their education by taking courses at Virginia Tech for college credit or, in some cases, degree credit. Such students include, but are not limited to, students enrolled in other colleges or universities and senior citizens. Non-degree applicants must be in good standing from all previously attended educational institutions with no serious disciplinary infractions. Students will not be competitive for admission if their most recent work is below a 2.0 or their cumulative GPA is below a 2.0.

Students who enroll at Virginia Tech under this program may not be considered candidates for degrees unless they apply formally for regular undergraduate or graduate admission. At that time, minimum requirements must be met and the applicant's academic and disciplinary record at Virginia Tech and all other colleges and universities attended would be reviewed within the context of the current competition for regular admission.

### Applying as a Non-Degree-Seeking Student

When applying as a non-degree-seeking student, the applicant must send the following materials to the admissions office:

- Official application for admission as a non-degree-seeking student, plus a \$60 application fee (non-refundable). (Please note: We expect students to apply online at [www.admiss.vt.edu](http://www.admiss.vt.edu).) Summer-only students should apply at [www.summer.vt.edu](http://www.summer.vt.edu).
- A letter explaining the purpose of attending Virginia Tech as a non-degree-seeking student. In some cases, the Admissions Committee may request an interview.
- Unofficial transcripts from all colleges and/or universities attended.

Non-degree seeking students may apply online at [www.admiss.vt.edu](http://www.admiss.vt.edu). The application should be submitted by the published deadline for the term selected (April 15 for Summer Session I, June 1 for Summer Session II, August 1 for Fall), as noted at [http://www.admiss.vt.edu/apply/non\\_degree/dates\\_deadlines.php](http://www.admiss.vt.edu/apply/non_degree/dates_deadlines.php). If accepted, the applicant will receive an official notice of admission via e-mail along with other related forms.

### Restrictions on Non-Degree-Seeking Students

- Students who have been denied admission to Virginia Tech as freshmen or transfer students for the same term will not be eligible for reconsideration as non-degree-seeking students.
- Non-degree-seeking students will be able to register on a space-available basis only. Until the deadline for adding classes, such students may be required to drop a class if the number of degree-seeking students exceeds the number of available spaces in a particular class.
- Non-degree-seeking students will be permitted to attempt up to 30 hours at Virginia Tech, not to exceed 11 hours in any one term during the academic year or 5 hours in either summer school term.
- Non-degree-seeking students are required to maintain an overall GPA of at least 2.0 for continued enrollment.
- Non-degree-seeking students are not eligible for financial aid, scholarships or on-campus housing.
- Students who have previously been enrolled at Virginia Tech may not reapply as non-degree-seeking students. Former students who left the university in good standing may register for classes through Hokie SPA (<http://www.hokiespa.vt.edu>).

## Admission (Transfer Process)

Admission is offered on a competitive basis to transfer applicants with the strongest academic records, as long as space is available in their chosen fields of study.

Competitive applicants will achieve mostly Bs or better. In majors where applications exceed available space, the competitive grades will be considerably higher. Architecture and industrial design are not available for

transfer applicants. The most important factors considered for admission are: completion or substantial progress toward completing prerequisite courses -- particularly freshman English, math and science appropriate for the intended major; and overall GPA in college course work.

Applicants from accredited colleges and universities, including applicants from Virginia community colleges who have completed two full academic years and have received an associate's degree in the University Parallel College/Transfer Program, must (1) have completed all entrance requirements, or their equivalents, in their college developmental program; (2) have a minimum GPA of "C" (2.0 on a 4.0 scale) in all previous college work attempted; and (3) be in good standing with all colleges or universities attended. The applicant's overall grade point average and the quality of the student's former academic program are critical factors in admissions considerations. Most transfer applicants who are offered admission have a minimum GPA of 3.0 (on a 4.0 scale). Prospective applicants from the Virginia Community College System will find information about guaranteed admissions agreements at <http://www.admiss.vt.edu/apply/virginia-community-college-system/>.

Transfer applicants must send the following application materials to the Office of Undergraduate Admissions:

- Official application and application fee (non-refundable): \$60 for freshmen, transfer, and non-degree students; \$70 for international students.

**Please note:** *we expect students to apply online at [www.admiss.vt.edu](http://www.admiss.vt.edu).*

- Unofficial or official transcripts covering all college-level course work, including dual enrollment high school courses through the last term enrolled. (To be cleared for final admission, applicants who have accepted the offer of admission must provide the admissions office with final official transcripts from all colleges previously attended.)
- A list of the courses in which the applicant is currently enrolled.
- Official and complete secondary school record, showing all grades and date of graduation. Transfer students must also meet minimum requirements set forth for high school students.
- Discharge certificate (DD214) if the applicant is a veteran.

NOTE: Applicants are expected to create guest account access to their online status page to monitor receipt of required supplemental materials, as instructed by e-mail after submitting their applications.

Completed applications are considered and decisions are made by the Admissions Committee. If offered admission, the applicant will receive an official notice of admission and related forms.

Transfer applications for summer/fall admission are due February 15, and will receive notification of the admissions decision by May 1. Students offered admission must respond to the offer by June 1. If space is available, transfer applications for spring admission are due October 1, decisions are mailed by November 15, and responses are due December 15.

## Advanced Placement

Through Advanced Placement examinations administered in May of each year by the College Entrance Examination Board, students receiving required scores may be considered for advanced placement credit in certain subjects in which they show proficiency. Final determination of credit will be made after the test results have been evaluated by the university. Students must have scores sent directly to the Office of the University Registrar at Virginia Tech (school code 5859) from the College Entrance Examination Board. If scores were not directed to the University Registrar at the time of the examination, contact the College Board at (888) 308-0013.

Credits allowed for advanced placement are shown as transfer hours on Hokie SPA. These credits, not to exceed 38 semester hours, are counted as hours passed when considering academic eligibility. Refer to the Office of the University Registrar's website at <http://www.registrar.vt.edu/registration/transfer/ap-ib-clep-credit.html> for information and to view the AP Credit Table. Questions about Advanced Placement credit should be directed to the Office of the University Registrar at [registrar@vt.edu](mailto:registrar@vt.edu).

## Advanced Standing

Advanced standing refers to an arrangement that permits a student to be placed in a course without having completed the normal prerequisites. Credit may be awarded for specific courses based upon grades achieved in specific external tests and/or achievements.

Advanced standing without credit will be allowed for satisfactory completion of one to five years of study in a foreign language in a secondary school.

Advanced standing with credit will be allowed for exceptional performances on certain tests and/or achievements in mathematics, English, and the International Baccalaureate program. Credit will not exceed 38 semester hours.

Credit by examination, not to exceed 12 semester hours, will be allowed by special examination where exceptional command of a subject is demonstrated.

Advanced Standing based on completion of any College-level Examination Program (CLEP) exams is granted at the discretion of the individual departments.

## Applying to Graduate School

Students interested in working toward an advanced degree at Virginia Tech should contact the Graduate School for an application (<http://www.graduateschool.vt.edu>).

### Undergraduate students enrolling in Graduate Programs or courses

Virginia Tech offers the opportunity to outstanding undergraduate students (Seniors/Juniors) nearing the end of their bachelor's degree program to enroll and receive credit for coursework taken to apply toward a future graduate program. Seniors with a GPA of 3.0 or better may apply to be admitted to the Dual Student Status for their last semester to take graduate-level courses. Juniors with a GPA of 3.3 or better may apply for admission in the Accelerated Undergraduate/Graduate Degree Program to take graduate courses during the senior year. Please check with your department to check for specific admissions requirements. Information about these programs is available on the Graduate School website (<http://www.graduateschool.vt.edu>)

### Taking graduate-level courses

Undergraduate students wishing to enroll in graduate-level courses may do so. You should review any restrictions listed for the course in the Timetable of classes and speak with the faculty member teaching the course to obtain permission. Please note that enrollment in a graduate-level course will not allow you to receive graduate credit for the course if you become a master's or doctoral degree-seeking student without first being admitted to either the Dual or Accelerated Undergraduate/Graduate Degree Program.

## Applying to Summer Sessions

Virginia Tech offers two summer sessions of approximately six weeks each. Credit courses on other than the regular time schedule, including intensive courses for teachers, are also offered. The summer sessions program features a comprehensive offering of courses and special programs, including online courses, study abroad programs, and a few undergraduate courses in Northern Virginia.

Enrolled Virginia Tech students, as well as visiting students, are invited to participate in summer sessions. Enrolled students follow the same registration procedure for summer courses as they would for fall and spring. New or visiting students may enroll in summer sessions in either a degree or non-degree status. Such students should visit [www.summer.vt.edu](http://www.summer.vt.edu) for information. Entering freshmen and transfer students should contact the Office of Undergraduate Admissions to be cleared for summer entry. Freshman applicants wishing to change term of entry to summer should e-mail [appchange@vt.edu](mailto:appchange@vt.edu). Entering graduate students should contact the [Graduate School](#).

On-campus housing is available in the summer. For more information, contact 540-231-6207 or [housing@vt.edu](mailto:housing@vt.edu), or go to [www.housing.vt.edu](http://www.housing.vt.edu).

Summer students have access to most university academic, athletic, and recreational facilities and programs, including the Horticulture Gardens and miles of cycling and walking trails. In addition, the [Summer Arts Festival](#) provides free movies, concerts, and exhibits.

Additional information is available at [www.summer.vt.edu](http://www.summer.vt.edu)

## Entrance Tests

Freshman applicants are required to take the SAT or ACT. (Students who opt to take only the ACT also should take the ACT writing test.) The SAT or ACT should be taken by the December test date of the senior year in high school or earlier, as scores are considered in the admissions application process. Information on these tests may be obtained from high school guidance directors or principals, or by writing directly to the College Entrance Examination Board, Princeton, New Jersey, or the ACT program in Iowa City, Iowa. The tests are given at centers in Virginia, in all other states, and in many foreign countries. The applicant should arrange to have all test scores sent directly to the admissions office by the testing agency or high school. Virginia Tech's CEEB number for reporting test scores is 5859. The ACT code is 4420.

Students who are homeschooled or graduating from a non-accredited high school are encouraged to also present either two SAT Subject Area test scores in math and a second area of study to be chosen by the applicant OR grades in two community college courses including one math course.

International applicants whose native language is not English, and American applicants who are English-speaking but whose native language is not English also are required to take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS) test.

## Equal Opportunity / Affirmative Action Statement

Virginia Tech does not discriminate against employees, students, or applicants on the basis of age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation or veteran status. Discrimination or harassment on any of these bases is prohibited by [Policy 1025](#), "Anti-Discrimination and Harassment Prevention Policy."

The university is subject to Titles VI and VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Sections 503 and 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act of 1990, the Age Discrimination in Employment Act, the Vietnam Era Veterans' Readjustment Assistant Act of 1974, the Federal Executive Order 11246, Virginia's State Executive Order Number Two, and all other rules and regulations that are applicable.

Those having questions or concerns about Policy 1025, any of these regulations, or related issues should contact:

Virginia Tech Human Resources  
Office for Equity and Access  
South Gate Center, Ste. 179 (0319)  
Blacksburg, VA 24061.  
(540) 231-9331

## International Baccalaureate

Virginia Tech recognizes the International Baccalaureate (IB) diploma or individual International Baccalaureate courses with advanced standing if the student scores at least a four on the International Baccalaureate higher-level examinations. The university encourages completion of the IB diploma. Students must have scores sent directly to the Office of the University Registrar at Virginia Tech from the IBO Board. If scores were not

directed to the University Registrar upon completion of the diploma or certificate, refer to the IBO website at <http://www.ibo.org/informationfor/alumni/transcripts/> for information on how to have the results sent.

The additional value of the complete IB diploma is recognized in evaluating a student's record for admission and for advanced standing with credits. Subsidiary level courses are considered for advanced standing only for students who complete the IB diploma. Up to 38 semester credit hours may be granted for those earning the IB diploma, and up to 30 semester credit hours for those earning the IB certificate. Credits granted for IB courses are shown as transfer hours on Hokie SPA. These credits are counted as hours passed when considering academic eligibility.

Refer to the Office of the University Registrar's website at <http://www.registrar.vt.edu/registration/transfer/ap-ib-clep-credit.html> for information and to view the IB Credit Table. Questions about IB credit should be directed to the Office of the University Registrar at [registrar@vt.edu](mailto:registrar@vt.edu).

## New Student Programs

**New Student Orientation:** Orientation is the first stepping-stone in the transition to Virginia Tech. During orientation, entering students will have the opportunity to interact with the student orientation team and other new students, learn about campus resources, as well as meet with college or department representatives and register for fall semester courses. Orientation is designed to give incoming Hokies and their guests the information they need to feel confident and comfortable about starting course work at Virginia Tech.

New freshmen and their guests have the opportunity to attend a two-day orientation session in July. Transfer students and their guests attend a one-day orientation session in June.

**Spring Orientation:** Students who will enter Virginia Tech in the spring semester are invited to attend the Spring Orientation program in January before the beginning of spring classes.

Information is available at [http://www.nsfp.vt.edu/new\\_student\\_orientation/](http://www.nsfp.vt.edu/new_student_orientation/)

**Hokie Camp:** After orientation and before you start your college experience, we invite you to attend Hokie Camp. Hokie Camp welcomes new Hokies with the purpose of giving them an opportunity to have fun, make friends and learn more about life at Virginia Tech. Hokie Camp is open to incoming freshmen and transfer students. Hokie Camp is a three-day, two-night orientation experience that will take place at the W.E. Skelton 4-H Educational Conference Center.

New Hokies will be split into color groups: Yellow, Red, Blue, Black, and Green. Students are split further into small groups of 8-9 campers (Building Groups, or BGs for short) and lead by one upper class Hokie Camp Counselor. Each camp will share a special bond as you get to know each other through low-rope activities, attending sessions on how to get involved on campus, learning about Hokie traditions and much more.

Information is available at [http://www.nsfp.vt.edu/hokie\\_camp/index.html](http://www.nsfp.vt.edu/hokie_camp/index.html)

**Hokie Hi:** Hokie Hi Welcome Week is a series of events and Hokie traditions designed to welcome all students back to campus. Students will kick off the school year by connecting with campus and the Hokie community through a variety of social and educational activities. Events include the Welcome Back Picnic in Lane Stadium, a movie on the Drillfield, Gobblerfest, and many more.

Information is available at [http://www.nsfp.vt.edu/hokie\\_hi/index.html](http://www.nsfp.vt.edu/hokie_hi/index.html)

## Requirements (Computer)

Students are required to have their own personal computer. The university annually establishes baseline specifications for each new entering class. Transfer students are subject to the requirement that was in place for students at the same class level into which they enter. Broad specifications are announced by mid-May for students entering in the fall of the next academic year. Some departments and colleges recommend a specific configuration from among the options outlined by the university. Virginia Tech requires that entering students

have a laptop or tablet computer and strongly recommends that entering students obtain a computer that meets (or exceeds) the university general specifications. If you have declared a major, check the college and department specifications. Complete information about the computer requirement can be found online at [www.compreq.vt.edu](http://www.compreq.vt.edu).

## Requirements (Minimum Freshman Entrance)

A student must complete a minimum of 18 units before enrolling at Virginia Tech. One unit is equal to one academic year of study in a selected course. Students who will graduate from a program other than an accredited high school program should check the 'What do we look for' section at [www.admiss.vt.edu](http://www.admiss.vt.edu), and contact the Office of Undergraduate Admissions for additional information.

At least 14 of the 18 units must be academic or college preparatory units. Academic or college preparatory units are courses in English, language studies, mathematics, natural sciences, social sciences, and fine arts. They must be distributed as indicated below. Admission to Virginia Tech is competitive, those offered admission have A/B averages.

Of the 18 required units, the following minimums must be met:

- **English** - 4 units, one in each year of high school.
- **Math** - 3 units, including algebra I, algebra II and geometry. Admission preference will be given to those who complete math beyond algebra II. A fourth unit of math is required for engineering, building construction, chemistry, computer science, mathematics, physics, and statistics majors. A fourth unit of math is strongly recommended for Pamplin College of Business majors. The fourth unit of math must include one-half unit of trigonometry and one-half unit of advanced algebra or higher mathematics. A fifth unit of math (e.g., calculus) is preferred for engineering majors.
- **Social Science** - 2 units; 1 unit must be in history.
- **Laboratory Science** - 2 units; units must be chosen from biology, chemistry, or physics. 3 units (including chemistry and physics) are recommended for engineering and for all science-related majors.
- **Additional Academic Units** - 3 units from college preparatory courses. These may be electively chosen from English, natural sciences, social sciences, history, mathematics, computer science, language studies, and fine arts. These courses must be comparable in content and purpose to other required academic or college preparatory courses.
- The remaining 4 units may be selected from any course offerings for which the high school grants credit toward graduation.

By the time they graduate from the university, students must meet a language study requirement. The minimum requirement may be met in high school by completing 2 units of a single foreign or classical language. Some majors in the College of Liberal Arts and Human Sciences and the College of Science may require 3 units. The requirement also may be met after admission by one of the following:

- Earning 6 semester hours of college-level foreign or classical language credit.
- Receiving credit by examination for a foreign or classical language.

Such credits are in addition to that number normally required for graduation.

Virginia Tech reserves the right to deny admission to students who have been dismissed or suspended for academic or disciplinary reasons or to those convicted of a felony or a serious misdemeanor impacting the safety of the university community.

## Student Health History

Each student entering Virginia Tech must furnish a health history form, completed by a home physician, for the University Student Health Services. The form will be available online to applicants who accept the offer of admission. Failure to meet Health Services standards may result in dismissal from the university. Information

is available at <http://www.healthcenter.vt.edu>.

## Transfer Student Credentials Evaluation

Official final academic transcripts from all colleges previously attended should be submitted to the Office of Undergraduate Admissions. Courses from another institution in which a grade of "C-" or lower was earned, and courses taken on a pass/fail or audit basis, are not acceptable for transfer credit. Grades in transfer courses do not transfer or appear on a student's record at Virginia Tech, and are not included in a student's Virginia Tech GPA computation. Only grades of "C" or higher in courses consistent with those offered at Virginia Tech are certified for transfer credit. Credit will be awarded based on Virginia Tech policies.

Courses for which a student received credit by exam, Advanced Placement (AP) credit, or credit for life experiences at another university are not transferable. AP, IB and CLEP scores should be sent directly to the University Registrar at Virginia Tech from the testing services; credit cannot be awarded from high school transcripts. Refer to the Office of the University Registrar's website at <http://www.registrar.vt.edu/registration/transfer/ap-ib-clep-credit.html> for contact information for testing services and to view the AP, IB, CLEP Credit Tables.

No more than 50 percent of the credits required for graduation from Virginia Tech may be transferred from two-year colleges. To receive transfer credit, official academic transcripts from all colleges previously attended should be received in the Office of the University Registrar no later than the end of the first term of the student's first enrollment at Virginia Tech. Class standing will be based upon the number of credits designated as acceptable for meeting graduation requirements. All transfer credits are used in the computation of academic eligibility.

International transfer students are required to submit additional documentation. For a list of required documentation see <http://www.admiss.vt.edu/apply/application-checklist/>.

Virginia Tech reserves the right to deny admission to students who have been dismissed or suspended for academic or disciplinary reasons or to those convicted of a felony or a serious misdemeanor impacting the safety of the University community.

## Transfer Policy of Virginia Community College Students

Per *State Policy on Transfer*, students who take their entire course work (native Virginia Community College or Richard Bland students) toward the baccalaureate degree by enrolling in transfer programs at a Virginia Community College or Richard Bland College, who graduate with associate degrees (appropriate for the major) based upon a baccalaureate-oriented sequence of courses, and who are offered admission to Virginia Tech will be granted junior level status upon admission. Additionally, these students will have fulfilled the requirements of the Curriculum for Liberal Education (CLE), except for departments with specific CLE requirements. However, it may take such students longer than two years to complete the baccalaureate degree because of major prerequisites and other circumstances or requirements. Non-native students are those students who do not begin their college work at a Virginia Community College, or transfer credits to the Virginia Community College to complete the transfer associate degree.

Admission preference shall be given to transfer students who have completed an A.A., A.S., or A.A.S. (Associate in Arts and Sciences) at the Virginia Community College System or Richard Bland College. While some courses from the Associate of Applied Science degree from a Virginia Community College or Richard Bland College may transfer to Virginia Tech, the Associate of Applied Science degree does not transfer. Transfer students shall have the same opportunities as other students in areas of residence and dining programs, registration, and scholarships and financial aid.

Complete [Virginia Tech Transfer Guide](#)

# 2016-2017 Undergraduate Course Catalog and Academic Policies

**Agriculture & Life Sciences**

**Architecture & Urban Studies**

**College of Engineering**

**Liberal Arts and Human Sciences**

**Natural Resources and Environment**

**Pamplin College of Business**

**College of Science**

**Veterinary Medicine**



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Using this Catalog

[Abbreviations](#)  
[Course Descriptions](#)  
[Changes in Catalog Information](#)  
[Course Numbering System](#)  
[Cross Listed Courses](#)  
[Graduate Course Listings](#)  
[Prerequisite Notations and Requirements](#)  
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[University Course Series \(UNIV\)](#)

## Abbreviations

Miscellaneous abbreviations used only in the course descriptions include:

<b>C-</b> credits	<b>I-</b> Fall semester
<b>Co-</b> corequisite	<b>II-</b> Spring semester
<b>H-</b> hours in classroom	<b>III-</b> First summer session
<b>L-</b> hours in laboratory	<b>IV-</b> Second summer session
<b>Pre-</b> prerequisite	

The Roman numeral designations for the terms in which courses are offered are intended only as general guides and do not indicate binding agreement to offer in those terms.

## Course Descriptions

**AAEC** - Agricultural and Applied Economics  
**ACIS** - Accounting and Information Systems  
**AFST** - Africana Studies  
**AHRM** - Apparel, Housing, and Resource Management  
**AINS** - American Indian Studies

**ALCE** - Agricultural, Leadership, and Community Education  
**ALS** - Agriculture and Life Sciences  
**AOE** - Aerospace and Ocean Engineering  
**APS** - Appalachian Studies  
**APSC** - Animal and Poultry Sciences  
**ARBC** - Arabic  
**ARCH** - Architecture  
**ART** - Art and Art History  
**AS** - Aerospace Studies (AFROTC)  
**AT** - Agricultural Technology  
**BC** - Building Construction  
**BCHM** - Biochemistry  
**BIOL** - Biological Sciences  
**BIT** - Business Information Technology  
**BMES** - Biomedical Engineering and Sciences  
**BMSP** - Biomedical Sciences and Pathobiology  
**BMVS** - Biomedical & Veterinary Sciences  
**BSE** - Biological Systems Engineering  
**BUS** - Business  
**C21S** - 21st Century Studies  
**CEE** - Civil and Environmental Engineering  
**CHE** - Chemical Engineering  
**CHEM** - Chemistry  
**CHN** - Chinese  
**CINE** - Cinema  
**CLA** - Classics  
**CMDA** - Computational Modeling and Data Analytics  
**CNST** - Construction  
**COMM** - Communication  
**COS** - College of Science  
**CRIM** - Criminology  
**CS** - Computer Science  
**CSES** - Crop and Soil Environmental Sciences  
**DASC** - Dairy Science  
**ECE** - Electrical and Computer Engineering  
**ECON** - Economics  
**EDCI** - Curriculum and Instruction  
**EDCT** - Career and Technical Education  
**EDEP** - Educational Psychology  
**EDIT** - Instructional Design & Tech  
**EDTE** - Technology Education  
**ENGE** - Engineering Education  
**ENGL** - English  
**ENGR** - Engineering  
**ENSC** - Environmental Science  
**ENT** - Entomology  
**ESM** - Engineering Science and Mechanics  
**FA** - Fine Arts  
**FIN** - Finance, Insurance, Business Law  
**FIW** - Fisheries and Wildlife Sciences  
**FL** - Foreign Language

**FREC** - Forest Resources and Environmental Conservation  
**FR** - French  
**FST** - Food Science and Technology  
**GEOG** - Geography  
**GEOS** - Geosciences  
**GER** - German  
**GR** - Greek  
**HD** - Human Development  
**HEB** - Hebrew  
**HIST** - History  
**HNFE** - Human Nutrition, Foods and Exercise  
**HORT** - Horticulture  
**HTM** - Hospitality and Tourism Management  
**HUM** - Humanities  
**IDS** - Industrial Design  
**IS** - International Studies  
**ISC** - Integrated Science  
**ISE** - Industrial and Systems Engineering  
**ITAL** - Italian  
**ITDS** - Interior Design  
**JPN** - Japanese  
**JUD** - Judaic Studies  
**LAHS** - Liberal Arts and Human Sciences  
**LAR** - Landscape Architecture  
**LAT** - Latin  
**LDRS** - Leadership Studies  
**MASC** - Mathematical Sciences  
**MATH** - Mathematics  
**ME** - Mechanical Engineering  
**MGT** - Management  
**MINE** - Mining and Minerals Engineering  
**MKTG** - Marketing  
**MN** - Military Navy (NROTC)  
**MS** - Military Science (AROTC)  
**MSE** - Materials Science and Engineering  
**MTRG** - Meteorology  
**MUS** - Music  
**NANO** - Nanoscience  
**NEUR** - Neuroscience  
**NR** - Natural Resources  
**NSEG** - Nuclear Science Engineering  
**PHIL** - Philosophy  
**PHS** - Population Health Sciences  
**PHYS** - Physics  
**PORT** - Portuguese  
**PPWS** - Plant Pathology, Physiology, and Weed Science  
**PSCI** - Political Science  
**PSVP** - Peace Studies  
**PSYC** - Psychology  
**REAL** - Real Estate  
**RLCL** - Religion and Culture

**RUS** - Russian  
**SBIO** - Sustainable Biomaterials  
**SOC** - Sociology  
**SPAN** - Spanish  
**SPIA** - School of Public and International Affairs  
**STAT** - Statistics  
**STL** - Science, Technology, and Law  
**STS** - Science Technology Studies  
**SYSB** - Systems Biology  
**TA** - Theatre Arts  
**UAP** - Urban Affairs and Planning  
**UH** - University Honors  
**UNIV** - University Course Series  
**VM** - Veterinary Medicine  
**WGS** - Women's and Gender Studies

## Changes in Catalog Information

**Caution:** The course offerings and requirements of Virginia Tech are under examination and revision continually. This catalog presents the offerings and requirements in effect at time of publication, but in no way guarantees that they will not be changed or revoked. The regulations and policies may change to meet new needs or as legislation is approved. Such changes are published in the President's Policy Memoranda.

The policies and regulations that appear in this catalog are not meant to form a contract or to constitute an offer of one. Current information may be obtained from the following:

- *Undergraduate Admission Requirements:* **Director of Admissions.**
- *Course Offerings:* **Academic departments offering the course(s) in question.**
- *Degree Requirements:* **Office of the University Registrar, head of major department, or academic dean of the college.**
- *Fees and Tuition:* **Office of the University Bursar.**

## Course Numbering System

The first digit in course number designations denotes the year in which the course ordinarily is found in the curricular outlines or "checksheets," which are available from the major department or academic advisor. The second and third digits make the course number unique within a department. The fourth digit is 4 if the course is a one-term terminal course, 5 if the course is the first term in a sequence, and 6 if the second term in a sequence. As a general rule, courses with 0 as the first digit do not carry university credit. Agricultural Technology courses, however, are an exception.

## Cross Listed Courses

Courses that are cross listed between departments may not be counted twice toward meeting graduation requirements. No credit will be allowed for a course taken that duplicates subject matter in a course for which credit already has been received. Cross listed courses are indicated in the title line of course descriptions; for instance, REL 3454 is listed as follows:

- 3454 (PHIL 3454): PHILOSOPHY OF RELIGION

The first number is the Religion course number, while the number in parentheses indicates that the course is cross listed with Philosophy.

# Graduate Course Listings

Information regarding graduate courses (5000 and above) may be found in the [Graduate Catalog](#).

## Prerequisite Notations and Requirements

Students are permitted to take courses without having the specified prerequisites only upon obtaining the consent of the instructor. Students who enroll in a course for which they have not clearly satisfied the prerequisites or equivalent, or obtained the appropriate permission, may be dropped from the course. Deliberately false statements testifying to the satisfaction of prerequisites constitute a violation of the honor code. Students have the right to appeal a decision about prerequisites to the head of the department offering a course. Students should recognize that 3000 and 4000 level courses assume a certain level of academic maturity and general background regardless of the stated prerequisites. The course instructor can be consulted regarding the implications of this expectation for a specific course. Students must consult with the instructor if they wish to use the Pass/Fail option in a course for which they do not have the prerequisites.

Students should note prerequisite and corequisite requirements as stated in the course descriptions. Courses in a series may be taken independently where the series of course numbers is separated by commas (e.g., 3135, 3136), in the catalog listing. Where the series of course numbers is connected by hyphens (e.g., 4135-4136), the first course is prerequisite for the next one.

## Tables

The numbers on the right hand side of tables listed under certain departments denote the number of hours the class meets each week during the term and, in parentheses, the number of credits allowed for the course. A listing such as 3(3) means that the course meets three hours each week and three credits are earned.

## University Course Series (UNIV)

University Course Series are courses sponsored to enhance the undergraduate academic experience. The courses may not count toward degree credit. Check with your advisor or academic dean to verify degree applicability.

### Undergraduate Course Descriptions (UNIV)

#### 1004: COLLEGE SUCCESS STRATEGIES

Study and application of strategies, skills, attitudes and behaviors leading to effective academic learning in a college setting. Credit not applicable to meeting degree requirements; may not be repeated. (3H,3C)

#### 1704: FIRST YEAR SEMINAR COURSE

Introductory exploration of academic and social competencies contexts and responsible decision-making within a residential learning community environment. Pre: Consent required. May not count towards degree requirements; consult advisor. (3H,3C)

#### 1824: PATHWAYS TO SUCCESS: EXPLORING YOUR FUTURE

First-year experience course for University Studies majors. Designed to establish fundamental knowledge and skills that facilitate success. Various activities incorporate problem solving, inquiry, and integration of knowledge. (3H,3C)

#### 1984: SPECIAL STUDY

Variable credit course.

#### 2004: EXPLORING CAREERS: MAKING DECISIONS AND PLANS

Integrates the role of careers in society, career development theories, decision making models and styles and self-assessment interpretation. Analyzes career and major research, introduces job search strategies and defines professional behavior required in the workplace. Facilitates effective decisions in the choice of

academic majors and career options. Pass/Fail only. (3H,3C)

**2394: INTRODUCTION TO RESIDENTIAL COMMUNITIES AND LEADERSHIP**

This course provides theories, basic principles, and skill development that serve as a knowledge base and framework for the peer helping, para-professional Resident Advisor position. This course is open only to students who are serving in their first semester as a Resident Advisor. (3H,3C)

**2984: SPECIAL STUDY**

Variable credit course.

**3954: STUDY ABROAD**

Variable credit course. X-grade allowed.

**4984: SPECIAL STUDY**

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

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## Academic Common Market Programs

Virginia Tech has discontinued participation in the Academic Common Market for all majors effective fall 2012. **Undergraduate** students currently approved for participation in an Academic Common Market (ACM) major may continue to receive benefits as long as they are continuously enrolled full time in the ACM approved major (not to exceed six (6) years following this discontinuance), maintain a 2.0 overall grade point average, and satisfactory progress toward the degree.

## Auditing

Students are assessed the same rate for tuition and fees for auditing courses as for courses taken for credit.

## Billing Statements (E-Bill)

Student Accounts are billed electronically. Current e-bills, e-bill history, and real-time current account activity are viewed in the e-billing system accessed through the student portal (Hokie SPA). E-bills are posted at least monthly, on the 15th (if the 15th of the month occurs on a weekend, e-bills are posted on the Friday before the 15th). Payment is required by due date on the statement to avoid penalties such as a late fee, registration hold, and cancellation of registration.

The initial e-bill for fall semester 2016 will be posted July 15, 2016 and will be due August 10, 2016. Charges for new activity after July 15 and payments made to date will be e-billed on August 15, and again on August 29, 2016. All charges billed between July 15 and August 29, 2016 must be paid by midnight September 5, 2016 or classes may be dropped for non-payment.

The initial e-bill for spring semester 2017 will be processed in December 2016. A schedule similar to the fall e-bill schedule is followed. All charges for the fall and spring semesters must be paid by the close of the 10th class day, one week following the last day to add classes each semester, or classes may be dropped for non-payment.

E-bills for the summer and winter terms will be posted at least one month prior to the start of each term.

Past due charges will prevent access to drop add and prevent pre-registration for the upcoming semester. Finance charges are incurred for past due charges from a prior semester.

## Budget Tuition Plan

Virginia Tech's Budget Tuition Plan (BTP) offers a convenient method for planning and budgeting payment of tuition, fees, room, and board. The BTP can cover all or part of the semester institutional charges. This plan provides the opportunity for the student to enroll and remit payments. The only cost for this service is a non-refundable application fee that is due with the application each semester. Students can join the BTP online through Hokie SPA or download the BTP Brochure & application from our website. Visit [www.bursar.vt.edu](http://www.bursar.vt.edu) for additional information and online tutorials.

## Bursar

The Office of the University Bursar is responsible for the billing of tuition, fees, housing, dining plans and many other student and related charges. Billing statements are electronically generated monthly for new account activity and any previous balance. The e-bill can be viewed on the student portal Hokie SPA and payment can be made by e-check or by credit card. Payment can also be made by mail or in person at the Bursar Office in 150 Student Services Building.

Students may authorize parents or others as payers on their e-bill account. Unless revoked by the student, the authorized payer receives the e-bill notification monthly and is able to view the account and make payments electronically to the student's account.

Release of Financial Information to a third party such as parent(s) and/or guardian(s) requires student authorization under the Family Educational Rights and Privacy Act (FERPA). The FERPA disclosure can be done via the Hokie SPA.

Detailed information regarding tuition and fees, payment deadlines, customer service window hours, the Budget Tuition Plan, electronic billing and payment processes, and much more are available on the Bursar's website [www.bursar.vt.edu](http://www.bursar.vt.edu).

## Collection of Past Due Receivables for Students



Any amount owed to the university including, but not limited to, tuition, fees, room, board, loans, notes receivable, and amounts due for goods and services provided is considered a receivable to the university. A receivable becomes past due if payment is not received by the payment due date. At ninety days past due, the receivable becomes delinquent.

For currently enrolled students, the primary collection tool is the placement of a "HOLD" by the Office of the University Bursar on a student's record. This "HOLD" restricts certain student activities such as the ability to add or drop classes, receive grade transcripts, register for future academic terms, and may also result in a hold on your diploma if you are a candidate for graduation. Once established, the "HOLD" remains in place until the debt is paid in full. When a student is no longer enrolled, the collection procedures utilized for other "non-student" receivables are implemented.

Individuals are responsible to pay all fees and charges owed to Virginia Tech. If the individual defaults on payment, has a returned check, e-check, or debit of said fees and charges, or has any delinquent amount owed, the individual must pay a penalty fee, interest at the highest rate allowed by law or as agreed to with Virginia Tech, and all reasonable administrative costs, collections fees, and attorney's fees incurred in the collection of amounts due the university. Students will be notified by an email sent to their Virginia Tech email address to alert them that a statement has been generated. Virginia Tech and their respective agents or contractors may contact individuals regarding any amounts owed, at the current or any future number provided for the cellular phone or other wireless device using automated telephone dialing equipment or artificial or pre-recorded voice or text messages.

Addresses must be kept current and can be changed by students as needed on Hokie SPA (MyVT). Non-receipt of e-bill notification is not a valid defense for non-payment; it is the responsibility of the individual who has incurred the debt to see that the debt is discharged.

For non-students, a dunning message is included on each month's statement alerting the customer to the next collection steps that will be taken. If payment is not forthcoming within the stated period, the account and all pertinent information are forwarded to an outside collection agency for further collection efforts. In addition, the account is reported to national credit bureaus, thus affecting the debtor's credit rating.

In addition to the above measures, the university also lists the account with the Virginia Department of Taxation for set-off debt collection procedures. This means that any state income tax refund or payment processed through the State Treasurer's Office to the debtor will be reduced by the amount of the receivable owed by the debtor.

**Office of the University Bursar (0143)**  
Student Services Building, Suite 150, Virginia Tech  
800 Washington Street SW  
Blacksburg, VA 24061  
540/231-6277  
Fax: 540/231-3238  
**E-mail:** [bursar@vt.edu](mailto:bursar@vt.edu)  
**Web:** <http://www.bursar.vt.edu>

## Eligibility for In-State Student Tuition Privileges

**General Information:** Eligibility for in-state tuition privileges (reduced tuition charges) is governed by §23-7.4 of the Code of Virginia. The provisions of §23-7.4 of the Code of Virginia are set forth, defined, and discussed in the [State Council of Higher Education for Virginia's Domicile Guidelines](#). SCHEV developed these Guidelines to facilitate the consideration of uniform criteria in determining domiciliary status. §23-7.4 of the Code of Virginia places the responsibility on the student for establishing by clear and convincing evidence that s/he is eligible for the in-state tuition rate. Further, the burden is on the applicant to demonstrate by clear and convincing evidence that his/her domicile is Virginia and that s/he has abandoned any prior domicile. According to SCHEV's Guidelines, clear and convincing evidence is defined as "that degree of proof that will produce a firm conviction or a firm belief as to the facts sought to be established. The evidence must justify the claim both clearly and convincingly."

**Domicile:** Domicile refers to the "present, fixed home of an individual to which he or she returns following temporary absences, and at which the individual intends to remain indefinitely. No individual may have more than one domicile at a time." Domicile cannot be initially established in Virginia unless one actually resides, in the sense of being physically present, in Virginia with domiciliary intent, which means present intent to remain indefinitely, that is, the individual has no plans or expectation to move from Virginia. Residence in Virginia for a temporary purpose or stay, even if that stay is lengthy, with present intent to return to a former state or country upon completion of such purpose does not constitute domicile. "Mere physical presence or residency primarily for educational purposes does not confer domiciliary status. A person shall not ordinarily be able to establish domicile by performing acts which are auxiliary to fulfilling educational objectives or which are required or routinely performed by temporary residents of the Commonwealth. The university will consider many factors when determining domicile. Among them are continuous physical residence, state to which income taxes are paid, driver's license, voter registration, motor vehicle registration, employment, property ownership, sources of financial support, military records, a written offer and acceptance of employment in Virginia following graduation, and any other social or economic relationships with the Commonwealth and other jurisdictions. The presence of any or all of these factors does not automatically result in Virginia domicile. The factors used to support a claim of entitlement to in-state privileges must have existed for a minimum of one year (12 continuous months) prior to the first official day of classes.

**Military:** The following individuals shall be charged a rate of tuition not to exceed the in-state rate for tuition and fees purposes:

- A Veteran using educational assistance under either chapter 30 (Montgomery G.I. Bill - Active Duty Program) or chapter 33 (Post-9/11 G.I. Bill), of title 38, United States Code, who lives in Virginia while attending a school located in Virginia (regardless of his/her formal State of residence) and enrolls in the school within three years of discharge or release from a period of active duty service of 90 days or more.
- Anyone using transferred Post-9/11 GI Bill benefits (38 U.S.C. § 3319) who lives in Virginia while attending a school located in Virginia (regardless of his/her formal State of residence) and enrolls in the school within three years of the transferor's discharge or release from a period of active duty service of 90 days or more.
- Anyone described above while he or she remains continuously enrolled (other than during regularly scheduled breaks between courses, semesters, or terms) at the same school. The person so described must have enrolled in the school prior to the expiration of the three year period following discharge or release as described above and must be using educational benefits under either chapter 30 or chapter 33, of title 38, United States Code.
- Anyone using benefits under the Marine Gunnery Sergeant John David Fry Scholarship (38 U.S.C. § 3311(b)(9)) who lives in Virginia while attending a school located in Virginia (regardless of his/her formal State of residence).
- Anyone using transferred Post-9/11 G.I. Bill benefits (38 U.S.C. § 3319) who lives in Virginia while attending a school located in Virginia (regardless of his/her formal state of residence) and the transferor is a member of the uniformed service who is serving on active duty.

**Reclassification:** Students may seek reclassification of their initial tuition classification, but residence or physical presence in Virginia primarily to attend the university does not entitle students to in-state tuition rates. Domicile should be established BEFORE one enters the university. Please note that if a student enters the university classified as an out-of-state student, s/he must present clear and convincing evidence to rebut the presumption that s/he is residing in the state primarily to attend school. Students seeking reclassification to in-state status must be prepared to pay the out-of-state tuition rate unless they are notified in writing that his/her status has been reclassified to in-state according to the Code of Virginia.

**Application Deadlines:** According to §23-7.4 of the Code of Virginia, changes in domiciliary status can be granted prospectively only from the date the application is received; therefore, the deadline for submission of the complete application is prior to the first day of the term/semester for which the student seeks reclassification to in-state. Retroactive changes in status are not allowed under the Code. To ensure that students have a decision before the tuition payment deadline, please submit a complete application at least 30 days prior to the tuition payment deadline as published by the Office of the University Bursar. If additional

information is requested, the applicant must provide the additional information within 30 days of the date of the letter requesting the information. Tuition refunds may be given to students who paid their tuition at the out-of-state rate but were subsequently reclassified to in-state provided that the Application for Virginia In-State Tuition Rates was submitted before the first day of the term. Qualifying students should contact the Office of Student Accounts regarding eligibility for a refund.

**New Undergraduate or Transfer Students please contact:**

Office of Undergraduate Admissions  
925 Prices Fork Road, Mail Code 0202  
Blacksburg, VA 24061  
(540) 231-6267

**Continuing Undergraduate Students please contact:**

Office of the University Registrar  
Suite 250 Student Services Building  
800 Washington Street, SW, Mail Code 0134  
Blacksburg, VA 24061  
(540) 231-6252

The regulations governing domicile are determined by state law, and are therefore subject to change. The information stated herein is not intended to be a contract between a student and Virginia Tech but is provided for informational purposes only. For additional information, please visit [http://www.registrar.vt.edu/academic\\_records/in-state/index.html](http://www.registrar.vt.edu/academic_records/in-state/index.html).

## Enrollment Status (Full Time)

Certification of full-time student status, for most purposes, U.S. Department of Veterans Affairs (V.A.) educational benefits, Social Security benefits, loans, scholarships, and grants, is based on the following enrollment information: official undergraduate and College of Veterinary Medicine enrollment for each regular semester must be 12 or more credit hours and official graduate enrollment for each regular semester must be 9 or more credit hours. All courses must be in the A/F option, P/F option, or equivalent credit. Please note that courses taken under the audit option do not count toward the enrollment status. Participation in the Virginia Tech Cooperative Education program, National Student Exchange program, and International Student Exchange program reflects full-time enrollment. Certification of enrollment for V.A. educational benefits will reflect only those hours considered to be progress toward the degree or educational objective. Although considered to be enrolled full-time, students who participate in the Cooperative Education program are not eligible for V.A. educational benefits or federal financial aid during the terms in which they participate in the Co-Op program.

## Fees (Cooperative Education Program)

Students are assessed a Cooperative Education Program Fee of \$75 for each term a student is placed in industry employment while enrolled in the Cooperative Education Program. Details available on the Bursar's website <http://www.bursar.vt.edu>.

## Fees (Late Payment)

The late fee charge is 10% of unpaid balance up to a maximum of \$125 per term if payment is not received by the due date on the billing statement.

## Fees (Reinstatement)

Classes are dropped for non-payment of charges after the tenth day of classes for fall and spring semesters. A \$75.00 reinstatement fee and late payment fee will be assessed to students desiring to register once class registrations are cancelled due to non-payment of fees. Students will have five business days to report to the

Office of the University Bursar, 150 Student Services Building, to pay charges in full and have the hold removed from their record before the academic dean can reinstate courses. Students will be provided a memo showing payment has been made to present to the academic dean when requesting reinstatement of classes. Failure to remit payment within five business days of cancelled registration may result in denial of reinstatement request.

## Fees (Tuition)

Information on Tuition and Fee costs as well as costs for room and board can be viewed on the Bursar's website [Bursar's website \(www.bursar.vt.edu\)](http://www.bursar.vt.edu).

## Medical Resignations

A student resigning for medical reasons will be charged a daily tuition rate for each day enrolled.

Resignations for medical reasons must be recommended by Schiffert Health Center or Cook Counseling Center at Virginia Tech indicating the student is unable to continue in school due to medical reasons. Schiffert Health Center or Cook Counseling Center will recommend an effective date for a medical resignation. Recommendations are forwarded to the student's academic dean. It is the purview of the Academic Dean to approve the recommendation. The Academic Fee, Technology Fee, Capital Fee and Comprehensive Fees are non refundable and no reduction will be made after the first day of classes for resignations.

## Military Withdrawals

Students called into active military duty are encouraged to communicate with their advisors, instructors, and undergraduate or graduate deans to arrange "incompletes" or rescheduling of remaining work if their orders are received near the end of a term. However, if students request a withdrawal from the university, permission is granted without punitive action as well as granting a full refund of tuition and fees. This full refund is requested regardless of the date of the action of withdrawal. Procedurally, students (or their parents or guardians) are requested to provide copies of activation orders. If orders are unobtainable (in some emergency call-ups, this is possible), the University Registrar will telephone the company commander for verbal confirmation. Further, the University Registrar will serve as facilitator of this process for any advisor, instructor, or dean seeking verification of the students' military status. Students with Federal Financial Aid should be advised that full refund of tuition will result in an immediate requirement to commence repayment of aid. Students with federal financial aid are to be given the option of full or partial refund. Students are to work with their advisors and deans in requesting reinstatement to the university.

**Reinstatement:** All students leaving under the military withdrawal policy are entitled to reinstatement into the same program of study. Students are directed to seek advising from their advisors or academic deans. If absent more than five years, certain majors may require re-taking of specific major courses.

**Defer Initial Enrollment:** Students called up for active duty may defer initial enrollment (in the same major) if:

- The student returns to Virginia Tech after a cumulative absence of not more than five years, and
- The student provides notice of intent to return to Virginia Tech not later than three years after completion of the period of service.

## Payment Directions

The most efficient and direct methods of payment include the electronic payment accessible in the e-bill system and the Budget Tuition Plan.

If paying by mail, please make the check payable to Treasurer of Virginia Tech. Print the PDF version of the e-bill and enclose the remittance advice with your check to ensure proper payment application. Mail to Office of the University Bursar (MC0143), Student Services Building, Suite 150, Virginia Tech, 800 Washington

Street SW, Blacksburg, VA 24061. When mailing payment, please do not send cash.

Scholarship checks, payments made via a banking service, correspondence, and certified or express mail must be sent to the Office of the University Bursar (MC0143), Student Services Building, Suite 150, Virginia Tech, 800 Washington Street SW, Blacksburg, VA 24061. Please include a Virginia Tech student identification number on all correspondence and a Scholarship Reporting Form ([http://www.finaid.vt.edu/forms/documents/1617/1617\\_SCHNOT.pdf](http://www.finaid.vt.edu/forms/documents/1617/1617_SCHNOT.pdf)) with all scholarship checks.

## Refund Policy

A student can receive refunds from the university quickly and in the most efficient manner by having the refund deposited directly to a bank account. Living expense refunds from excess financial aid will be deposited directly to the bank account provided by the student. The student can enroll in direct deposit online through the Hokie SPA under the University Account information menu. If the student has not provided bank account information, refund checks will be mailed to the student's permanent address listed on Hokie SPA at the time the refund is processed. Refund checks will NOT be distributed at the Bursar's Office Customer Service windows. Requests for replacement refund checks must be in writing and will not be accepted by the Bursar's Office until 14 calendar days after the date the original check was issued and mailed.

## Refunds (Room and Board)

Students who purchase a declining balance dining plan will be charged a forfeiture fee of \$100 during the first week for a Major, Mega, or Premium dining plan and \$35 during the first week for a Minor Flex or Commuter Cash dining plan. Beginning in week two and throughout the remainder of the semester, students will forfeit the base cost and will be refunded any unused dollars in the declining balance account. Commuter Cash dining plan holders will receive a refund of the remaining dollars on the plan fees less a \$35 forfeiture fee. Refunds are calculated from the date the resignation is processed by the university or the last day of dining plan use, whichever is later. No refund will be granted for a resignation backdated for a previous semester.

Students with a balance in a Dining Dollars, Flex Additions, or Hokie Passport account will receive a credit on their student account of the balance less a \$15 processing fee per account. Questions concerning adjustments to room charges should be directed to the Office of Housing & Residence Life at (540) 231-6205. Questions concerning adjustments to dining plan charges should be directed to Hokie Passport Services at (540) 231-5121.

## Refunds (Tuition)

The refund schedules below list the student refund for withdrawals, resignations, and reduced course load. Students considering reducing their course load or resigning should always review examples of the calculation of any refund on the Bursar's website at [www.bursar.vt.edu](http://www.bursar.vt.edu) before actually dropping the course or resigning. Students receiving financial aid should contact the University Scholarships & Financial Aid Office prior to dropping the course to determine the impact on their financial aid.

Fees are defined as the comprehensive fees (full or part time) and any laboratory or resource fee associated with a particular course. When dropping a course, please note the non-refundable nature of fees after the first week of classes. Tuition and fee refunds for resignations are based on the effective date of resignation as determined by the student's associate dean. If there is a question related to the effective date of resignation, the student should contact their college.

Fall and Spring Semesters		Fall and Spring Semesters: <ul style="list-style-type: none"><li>All refunds will be calculated from the official date of resignation, which may not</li></ul>
<i>Tuition Refund Schedule for Reduced Course Loads</i>		
Semester Class Day	Student Refund	
One through five	100% of Tuition and Fees	

Six through eight	90% of Tuition ONLY	necessarily be the last day of class attendance.
Nine through nineteen	50% of Tuition ONLY	
Twenty through thirty-seven	25% of Tuition ONLY	
After day thirty-seven	0%	
<b><i>Tuition Refund Schedule for Withdrawals &amp; Resignations</i></b>		
<b>Semester Class Day</b>	<b>Student Refund</b>	<ul style="list-style-type: none"> <li>The technology, library, capital, comprehensive, laboratory and resource fees are non-refundable and no reduction will be made after the first day of classes for resignations and after the first 5 days of classes for reduced course loads.</li> </ul>
One	100% of Tuition and Fees	
Two through eight	90% of Tuition ONLY	
Nine through nineteen	50% of Tuition ONLY	
Twenty through thirty-seven	25% of Tuition ONLY	
After day thirty-seven	0%	
<b>Summer Terms</b>		
<b><i>Tuition Refund Schedule for Reduced Course Loads</i></b>		<b>Summer Terms:</b> <ul style="list-style-type: none"> <li>All refunds will be calculated from the official date of resignation, which may not necessarily be the last day of class attendance.</li> <li>No refund will be granted for a resignation that occurred in a previous fiscal year.</li> <li>The technology, library, capital, comprehensive, laboratory and resource fees are non-refundable and no reduction will be made after the first day of classes for resignations and after the first 3 days of classes for reduced course loads.</li> </ul>
<b>Semester Class Day</b>	<b>Student Refund</b>	
One through three	100% of Tuition and Fees	
Four through eight	50% of Tuition ONLY	
Nine through fifteen	25% of Tuition ONLY	
After day fifteen	0%	
<b><i>Tuition Refund Schedule for Withdrawals &amp; Resignations</i></b>		
<b>Semester Class Day</b>	<b>Student Refund</b>	
One	100% of Tuition and Fees	
Two through three	90% of Tuition ONLY	
Four through eight	50% of Tuition ONLY	
Nine through fifteen	25% of Tuition ONLY	
After day fifteen	0%	



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Financial Aid

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  - [Additional Information](#)
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Virginia Tech awards financial aid to eligible students in the form of scholarships, grants, loans, and employment. The majority of financial aid is intended for fulltime students with financial need.

To apply, entering freshmen, transfer students and returning Virginia Tech students should submit the Free Application for Federal Student Aid (FAFSA) electronically at <http://www.fafsa.gov>. The Office of University Scholarships and Financial Aid's priority deadline is January 15th for the upcoming academic year. The FAFSA will be available October 1, 2016.

The priority deadline applies to all financial aid programs except the Federal Pell Grant, Federal Direct Subsidized and Unsubsidized, Federal Direct Grad PLUS and Federal Direct Parent PLUS Loan Programs.

Applicants for scholarships and financial aid must list Virginia Tech's institutional school code number 003754 on the FAFSA for the analysis of the FAFSA to be sent to Virginia Tech. Students must complete and submit a new FAFSA each year to be considered for financial aid at Virginia Tech.

Beginning with the 2017-2018 academic year, the electronic FAFSA application will be available on October 1. All offers of financial aid are contingent upon receipt of anticipated federal and state funds by the university. Awards may be reduced or canceled if anticipated funds are not received. Offers of financial aid are subject to full-time enrollment and the student meeting the Satisfactory Academic Progress Policy requirements.

## Eligibility Requirements

To be eligible to receive aid from institutional, state, and federal need-based programs, an applicant must meet the following eligibility requirements: enroll or accepted for enrollment as a degree-seeking student; be a U.S. citizen or an eligible non-citizen; submit a complete FAFSA; and meet the Financial Aid Satisfactory Academic Progress Policy for Title IV recipients. Full-time enrollment is required for the majority of federal, state, and institutional programs. Students should consult with a financial aid advisor to determine how financial aid will be impacted for less than full time enrollment.

## Federal Title IV Programs

**The FAFSA is the application for all federal financial aid programs.**

**Federal Work-Study Program:** This federal program provides employment opportunities to students with demonstrated financial need. Eligible undergraduate and graduate students are limited to 20 hours of work per week while classes are in session. All Federal Work-Study Program jobs pay at least minimum wage.

**Federal Direct Loan Programs:** This federal program encompasses Federal Subsidized, Unsubsidized, Graduate PLUS, and Parent PLUS Loans.

- Federal Subsidized and Unsubsidized Loans are long-term; low-interest loans guaranteed by the federal government for the educational expenses of eligible students enrolled at least half-time. Repayment begins six months after the student ceases at least half-time enrollment.
- Federal Parent PLUS Loans are available to parents of undergraduate dependent students enrolled at least half-time. Parents may borrow up to the cost of attendance minus any financial aid for which the student qualifies. You must apply at [www.studentloans.gov](http://www.studentloans.gov) and an approved credit check is required.
- Federal Graduate PLUS Loans provide additional loan funds to graduate students that have exhausted eligibility in the Federal Unsubsidized Student Loan Program. You must apply at [www.studentloans.gov](http://www.studentloans.gov) and an approved credit check is required.

**Federal Perkins Loans:** This federal program provides long-term, low-interest loans to students with financial need. The interest rate is a fixed 5 percent. Repayment of both principal and interest begins 9 months after a student ceases to be enrolled at least half-time. The Federal Perkins program will end in 2017.

**Federal Pell Grant Program:** Federal Pell Grants are awarded to undergraduate students with high financial need. This program is intended to provide grant support to lower income families. Students must be pursuing a first bachelor's degree to receive the Federal Pell Grant.

**Federal Supplemental Educational Opportunity Grant:** Virginia Tech awards this federal grant to undergraduate students with extraordinary financial need. These funds are restricted to Pell-eligible students.

## Commonwealth of Virginia Programs

**Virginia Guaranteed Assistance Program:** Grants of up to the cost of tuition and fees are awarded by Virginia Tech from funds administered by the State Council of Higher Education for Virginia. Awards are made to eligible undergraduate residents of Virginia with demonstrated financial need. The list of requirements for this grant are available on our website.

**Commonwealth Award:** Awards are made by Virginia Tech from funds administered by the State Council of Higher Education for Virginia to Virginia residents seeking a first bachelor's degree with demonstrated financial need. The list of requirements for this grant are available on our website.

**Two-Year College Transfer Grant:** The Two-Year College Transfer Grant is administered by the State Council of Higher Education for Virginia. These grants are for undergraduate state residents who transfer from a community college with a 3.0 Grade Point Average (GPA) after completing an Associate's Degree at a Virginia two-year public institution. Recipients must maintain a 3.0 GPA and meet other requirements listed on our website.

**The Virginia Military Survivors and Dependent Education Program:** The Virginia Military Survivors and Dependents Education Program provides tuition and fee educational assistance for a maximum of 48 months to spouses and children of military service members killed, missing in action, taken prisoner, or who became at least 90 percent disabled as a result of military service in an armed conflict. This program was formerly named the Virginia War Orphans Education Program. To be eligible for assistance, application is made to the Virginia Department of Veterans Services.

**Academic Scholarships and Grants:** Merit based scholarships are for select undergraduate students who



establish outstanding academic record, including incoming freshmen through the academic department. Please refer to the scholarship section of our website for additional information. USFA offers the General Scholarship application through the electronic Scholarship Gateway at <http://www.finaid.vt.edu>. This application is available November 15th and **the deadline is February 15th**.

**Athletic Scholarships:** Admission and enrollment of students who are candidates for financial aid for which athletic ability is a consideration shall be conditional upon compliance with applicable regulations of the Atlantic Coast Conference and the National Collegiate Athletic Association.

**Veterans Affairs Educational Benefits (GI Bill):** Applicants who wish to receive VA Educational Benefits, including assistance through the Yellow Ribbon Program should contact the Office of Veterans Services or visit [www.veterans.vt.edu](http://www.veterans.vt.edu). Application information for veterans' benefits may be obtained from the nearest regional office of the Veterans' Administration. Students must enroll for a minimum of 12 credits each term to receive benefits as full-time students.

## Additional Information

Additional information on financial aid and scholarships may be obtained by contacting:

### **The Office of University Scholarships and Financial Aid**

Student Services Building, Suite 200

Virginia Tech

800 Washington Street SW

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All information is correct at the time of publication. Current information is available from the [University Scholarships and Financial Aid](#) website.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

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## Mission of the University

*Virginia Polytechnic Institute and State University (Virginia Tech), is a public land-grant university serving the Commonwealth of Virginia, the nation, and the world community. The discovery and dissemination of new knowledge are central to its mission. Through its focus on teaching and learning, research and discovery, and*

*outreach and engagement, the university creates, conveys, and applies knowledge to expand personal growth and opportunity, advance social and community development, foster economic competitiveness, and improve the quality of life.*

## Athletics, Intramurals, and Recreational Facilities

Virginia Tech has a diverse and highly active athletic program for men and women students in intercollegiate, intramural, and extramural sports. The athletic program is recognized as one of the most successful in the nation because it is geared to meet the needs of all students interested in physical and recreational sports activity.

The university has extensive and modern athletic and recreational facilities, including: Cassell Coliseum, an indoor arena seating 9,900; Lane Stadium, seating 65,632; a fully equipped recreation gymnasium, including War Memorial Pool; Rector Field House; Burrows-Burleson Tennis Center; English Baseball Field; outdoor tennis courts; the Pete Dye River Course of Virginia Tech and Virginia Tech Golf Course; Johnson/Miller Track Complex; Thompson Field for Soccer/Lacrosse; Tech Softball Park; a pond for ice skating in the winter; and the South Recreation Field Area for outdoor sports.

Virginia Tech's athletic varsity teams compete at the Division I level of the National Collegiate Athletic Association (NCAA). The university participates in the Atlantic Coast Conference for all varsity sports. Athletic scholarships are available in the following intercollegiate sports:

- Baseball (men)
- Basketball (men and women)
- Football (men)
- Golf (men)
- Lacrosse (women)
- Soccer (men and women)
- Softball (women)
- Swimming/Diving (men and women)
- Tennis (men and women)
- Indoor/Outdoor Track/Cross Country (men and women)
- Volleyball (women)
- Wrestling (men)

The following extramural sports clubs also are available: baseball (men's), basketball, bowling, clay target, competitive cheerleading, crew, cricket, cycling, equestrian, fencing, golf, women's field hockey, gymnastics, ice hockey, lacrosse, roller hockey, rugby, soccer, softball (women's), snow skiing, tennis, triathlon, volleyball, water polo, and wakeboard.

Virginia Tech offers a wide range of intramural and recreational programs for men and women including the following sports: basketball, billiards, bowling, chess, dodgeball, fantasy football, flag football, hearts tournament, racquetball, golf, innertube water polo, kickball, soccer, softball, swimming, table tennis, tennis, team darts, ultimate frisbee, volleyball, wallyball, and wiffleball.

**Venture Out** provides fun, safe, and educational outdoor services to the university community. Venture Out specializes in low-risk outdoor adventures, quality rental gear at unbeatable rates, and valuable resource materials. Venture Out is a healthy recreational alternative and allows the university community to enjoy all that Southwest Virginia has to offer, from hiking and camping, to kayaking, horseback riding, mountain biking, and skiing.

Venture Out

Phone: (540) 231-4982

E-mail: [ventureout@vt.edu](mailto:ventureout@vt.edu)

Web: [www.recports.vt.edu/content/venture-out](http://www.recports.vt.edu/content/venture-out)

## Cadet System

The Virginia Tech Corps of Cadets is one of only two programs in the United States offering a corps of cadets within a large public university. **The Corps of Cadets**, a militarily structured organization, offers many leadership development opportunities to both male and female students. The Rice Center for Leader Development offers a minor in leadership studies. Contact Dr. Elaine Humphrey, Director, (540) 231-9455 for additional information on the center.

The Corps is supervised by the Commandant of Cadets, who establishes overall policies and methods of operation for the Corps. The cadet commanders and staff officers are responsible for implementation of policies and procedures.

Membership in the Corps involves a 24-hour-a-day commitment. Members wear a distinctive Virginia Tech cadet uniform and live in designated cadet residence halls. Both cadets and non-cadets are part of one student body, attend the same classes, and are organized into one student government. Cadets participate in all university activities, including athletics, social events, and cultural programs. Membership in the Cadet Regimental Band, the "Highly-Tighties," is restricted to cadets. Although many benefits are available through participation in one of the three ROTC programs offered at Tech, a student does not have to enroll in an ROTC program to be a member of the Corps of Cadets.

## Career Services

Career Services, a unit of the Division of Student Affairs, works with students of all academic levels and all majors to assist with the following:

- **Making career decisions and plans.** Whether students are trying to decide on an academic major or a career field, Career Advisors on staff are ready to assist. Self-assessment tools are used to help students identify their unique strengths, interests, values, and personality type. Students can find a variety of career information through the Career Services web site ([www.career.vt.edu](http://www.career.vt.edu)) and in the Career Resource Library in the Smith Career Center.
- **Gaining career-related experience while in school.** Increasingly, employers expect students to have experience in their chosen field before graduation. In addition to administering the Cooperative Education and Internship Program (detailed below), Career Services provides hundreds of internship job listings through Hokies4Hire, their on-line resume referral database and job listing service, and sponsors the Connection Job Fair each fall and spring semester.
- **Determining post-graduation career plans** - which typically involves seeking full-time employment or applying to graduate or professional school. Career Services offers a full range of services related to educating students about the job search process including resume and cover letter critiques, practice interviews, seminars on business etiquette, and more. Through the Hokies4Hire system, students have access to thousands of job listings and opportunities to connect with employers through the On-Campus Interviewing Program. Additionally, the Health Professions Advising Program is located within Career Services and is dedicated to assisting students who are interested in continuing their education to pursue a health related occupation.

Information about all of Career Services' resources, services and programs - including an events calendar - is located at [www.career.vt.edu](http://www.career.vt.edu). To meet with a Career Advisor to discuss any of these topics, students can schedule an appointment by calling (540) 231-6241 or by visiting Career Services during 10-minute walk-in hours, Monday - Friday, noon - 3:00pm. Career Services is located in the Smith Career Center on the corner of Washington Street and West Campus Drive.

## Cooperative Education & Internship Program

The Cooperative Education & Internship Program (CEIP) is an academic program that provides students the opportunity to combine real world work experience with classroom theory. It involves one or more semesters of

paid or unpaid, full-time work and is a partnership among the student, Career Services, the academic department, and the employer. Gaining career-related experience gives the co-op/internship student the opportunity to test career goals, develop key experience and skills, defray the costs of a college education, and gain an important edge in the full-time employment market. The student transcript will indicate CEIP enrollment during the term(s) worked.

The CEIP Orientation is required of all students who plan to enroll in the Cooperative Education & Internship Program. Seminars are scheduled throughout the year and are designed to walk prospective co-op and internship students through the process of enrollment in the CEIP. Please call (540) 231-6241 or visit <http://www.career.vt.edu/COOP/COOP1.html> to find out more.

### **Requirements for participation in the CEIP**

- Students must maintain a cumulative GPA of 2.0.
- Students can begin work the summer after their freshman year, at the earliest. Transfer students must have completed at least one semester and earned a GPA of at least 2.0 at Virginia Tech.
- The co-op or internship job must be a full-time opportunity.

### **Additional Notes**

- The CEIP is open to any undergraduate student in any major.
- The Graduate School administers the graduate Co-op and Internship Program.
- To see where our current students are working, visit <http://www.career.vt.edu/CEIP/EmployersListByMajor.asp>

## **Counseling Center (Thomas E. Cook Counseling Center)**

240 McComas Hall and 107 East Eggleston Hall

The Cook Counseling Center provides individual, group and couples counseling; as well as crisis intervention, psychiatric care, and referral to qualified community practitioners. The Center offers workshops and outreach presentations to the campus community on a variety of topics, including stress management, relaxation training, and study skills assistance. The professional staff members are able to consult with parents, faculty and staff. A counselor is on-call after hours and can be reached by calling (540) 231-6557.

The Cook Counseling Center's diverse clinical and administrative staff is made up of caring and experienced professionals. All services are covered by payment of the student health fee. An appointment can be made by calling (540) 231-6557 or stopping by the office located in 240 McComas Hall or 107 East Eggleston Hall.

## **Dean of Students Office**

The mission of the Dean of Students Office is to foster a welcoming community for all students. The office supports the transition to college life, leads the response to student emergencies, and serves as a voice for student concerns within the broader community and serves as the primary point of contact for Hokie parents.

Members of the Dean of Students staff are available to meet with students on a walk-in basis, although appointments are appreciated. For more information or assistance, contact the Dean of Students Office at 109 E. Eggleston Hall, (540) 231-3787, or [dean.students@vt.edu](mailto:dean.students@vt.edu)

- Advocacy for all students
- Emergency response for students and parents
- New Student Programs, including Orientation, Hokie Camp, and Hokie Hi

## **Division of Student Affairs**

The Division of Student Affairs at Virginia Tech encompasses vital departments dedicated to providing a rich

co-curricular experience and essential student services. Virtually every aspect of a student's life outside the classroom is represented through its departments.

The division strives to create environments, programs, and services that support the university's teaching and learning focus and its mission to 'expand personal growth and opportunity, advance social and community development, foster economic competitiveness, and improve the quality of life.'

The Division of Student Affairs consists of the following departments: Career Services, Cook Counseling Center, Corps of Cadets, Cranwell International Center, Dean of Students Office, Fraternity and Sorority Life, Housing and Dining Services, Multicultural Programs and Services, Recreational Sports, Residence Life, Schiffert Health Center (including Campus Alcohol Abuse Prevention Center), Services for Students with Disabilities, Student Activities, Student Conduct, and University Unions.

Each of the division's programs provide ethical, social, and civic leadership for all students. One of the greatest responsibilities of the Division of Student Affairs is to prepare Virginia Tech students to be ethical leaders in an ever-changing society.

A detailed statement of the rights and responsibilities of students is contained in the University Policies for Student Life.

## First-Year Experiences

Virginia Tech's signature first-year experience (FYE) initiative includes courses specific for first time first-year and transfer students. Each course is designed to enhance the student experience within the major through focus in the discipline(s) and emphasis on fostering the abilities of the students to:

- Problem solve
- Explore and use information appropriately and effectively, and
- Integrate ideas and experiences and apply them to new learning situations within and beyond campus.

The programmatic goal is to provide experiences that will enhance the students' ability to thrive in the first year and beyond through:

- Advising and mentoring students,
- Connecting campus community,
- Fostering inclusivity,
- Supporting ethical use of information,
- And demonstrating effective teaching practice

A description of each program with contact information can be found at <http://www.fye.vt.edu>.

## Honor Code and Honor System

The Honor Code is the university policy which defines the expected standards of conduct in academic affairs. The Virginia Tech Honor Code embodies a spirit of mutual trust and intellectual honesty that is central to the very nature of the university and represents the highest possible expression of shared values among the members of the university community.

The fundamental beliefs underlying and reflected in the Honor Code are: that trust in a person is a positive force in making that person worthy of trust, that every student has the right to live in an academic environment that is free from the injustices caused by any form of intellectual dishonesty, and that the honesty and integrity of all members of the university community contribute to its quest for truth.

The functions of the Honor System are to communicate the meaning and importance of intellectual honesty to all students of the university; to articulate and support the interest of the community in maintaining the highest standards of conduct in academic affairs; and to identify, sanction, and educate those who fail to live up to the stated expectation of the university community with regard to these standards. (Please see the "[Academics](#)")

section of this catalog for details relating to the Honor Code and System.)

## Information Technology

Information Technology supports computing and communications including voice and data communications, instructional technologies, administrative processing, software support, high performance research computation, and individual help and tutorials. The website [www.computing.vt.edu](http://www.computing.vt.edu) is a guide to specific services and support.

The data network provides rapid access to email, class materials, library databases, and to the Internet for every resident in university housing. Wireless network access is available in most academic and administrative spaces across campus. Wireless facilitates mobility across the campus and, in conjunction with the university computer requirement for laptops, tablet computers, and software, is used in the classroom setting to improve the effectiveness of teaching and learning.

Virginia Tech is committed to using information technology to enhance teaching and learning and works to ensure that teaching faculty members have the ability to use information technology effectively. Instructional faculty members have continuing opportunities to engage with emerging technologies and to practice with both established and emerging technologies to achieve enhanced learning outcomes for students. Information Technology supports learning experiences through the online Scholar course management system, online course evaluations, and support for video production and distribution for both on-campus and distance learning classes. The required undergraduate student software bundle and other instruction-related software are offered at favorable pricing to students.

Direct support to students in information technology is provided through the 24x7 help resource, 4Help ([www.4help.vt.edu](http://www.4help.vt.edu)). No-cost loans of over a hundred different pieces of equipment are offered through InnovationSpace ([www.is.vt.edu](http://www.is.vt.edu)). These include video cameras, still cameras, audio recorders, iPads, lighting, microphones, and tripods, on-site use of video and audio editing software, various drawing tablets, and scanning devices. Classes on this hardware and software are free through iLearn workshops ([www.ilearn.is.vt.edu](http://www.ilearn.is.vt.edu)). Computer labs offer additional options for collaboration and for access to highly specialized software. Each student is provided an email account and access to file space for storage or websites.

My VT ([www.my.vt.edu](http://www.my.vt.edu)) provides secure access to personal information, including course materials, one's own contact information, and billing and account information. Security of this and other information is overseen by the Information Technology Security Office ([www.security.vt.edu](http://www.security.vt.edu)), protected through careful maintenance of strong passwords and online credentials, and incorporated into development of new applications.

Information Technology facilitates undergraduate, graduate, and faculty research through high performance networks and high performance computing, as well as through on-going professional development support, acquisition of specialized research software, and collaborative research.

For more on the Information Technology organization, see [www.it.vt.edu](http://www.it.vt.edu).

## Living and Dining On-Campus

### Housing and Residence Life

Housing and Residence Life provides facilities and services for more than 9,300 students who live in the residence halls on campus.

Residence halls vary in size and shape, and students may live in traditional rooms, hotel-style rooms, or suites, on single-sex or coeducational halls. Staff members promote the academic success and personal growth of residents through community development, peer advising, involvement, student advocacy, programming, and policy enforcement.

Each residence hall is staffed with student resident advisors who are responsible for community development,

programming, and behavioral conduct, with assistance from student management or professional staff. In addition, the Residence Hall Federation (RHF) focuses on improving the quality of residence hall living and implementing educational social programs for the resident communities. All residence hall students are automatically members of the RHF. Numerous leadership opportunities are available within this student organization.

Housing and Residence Life offers 15 different living-learning communities (LLCs) options for students. Students participating in LLCs are assigned to the same floor/residence hall(s) and share a common experience. Both first year and upper-division students are eligible to live in a LLC. There are four types of LLCs available to students at Virginia Tech:

- **Academic Major:** Students in academic major learning communities must be in one of the eligible majors to participate in these communities. Currently all academic major LLCs are STEM based.
- **Enhanced Learning Community:** Enhanced learning communities are experiences based around a common interest area. Current programs focus on: service, leadership, honors housing, military, and entrepreneurship.
- **Residential College:** Residential colleges allow for students of all ages (first year through graduate) and all majors to live together. These communities are led by a live-in "faculty principal" who provides both social and academic programming for the community.
- **Themed Housing:** Theme housing allows students to live together around a shared theme (e.g. greek life).

All first-year students live on campus unless they fall into one of the following categories: those living with parents or other close relatives, those who are married and living with their spouses, veterans of at least six months of military service, or those who are at least 21 years old. Written requests for exceptions to this policy should be directed to Housing and Residence Life in 144 New Hall West, (0428).

Campus housing is also available, but not guaranteed, for other students. Transfer and graduate/professional students may request housing through an online wait list. A lottery-style housing application process is held each spring to allocate residential space to returning undergraduate students who wish to live on campus.

## Dining Services

Numerous dining options are available for both on-campus and off-campus students, as well as for faculty, staff, and campus visitors. All on-campus residents choose an individual Major, Mega, or Premium Flex Plan. Off-campus students may select one of six individual dining plans or participate in the Dining Dollars program. Over 11,000 off-campus students opt to have a dining plan each year.

Dining at Virginia Tech is anything but traditional. The award-winning dining program specializes in preparing diverse menus in innovative, exciting venues:

- **Au Bon Pain** operates dining venues in three campus locations.
  - Au Bon Pain in the Squires Food Court at Squires Student Center serves distinctive bakery items, upscale sandwiches, and signature soups.
  - Au Bon Pain at the Graduate Life Center serves many of the same bakery and sandwich options, as well as grab-n-go items, as the cafe in Squires Student Center. This location serves students living and studying in the Graduate Life Center.
  - Au Bon Pain at Goodwin Hall offers students on the academic side of campus a dining option that serves many of the same items as the location in Squires Student Center.
- **Burger '37** in the Squires Food Court at Squires Student Center offers gourmet beef, turkey, and vegetarian burgers, hand-cut fries, and classic shakes.
- **D2** at Dietrick Hall takes traditional dining to the next level by combining all-you-care-to-eat dining with the variety of an international marketplace and includes a shop dedicated to gluten-free, vegetarian, and vegan specialties.
- **Deet's Place** at Dietrick Hall is a gourmet coffee, ice cream, and pastry shop, complete with award-winning coffee beans roasted in-house.



- **DXpress** at Dietrick Hall is perfect for a quick snack on the run, such as biscuits, burgers, and pizza by the slice, and is open until 2:00a.m. for late-night options.
- **Hokie Grill & Co.** at Owens Hall features national brands Chick-fil-A, Pizza Hut, and Dunkin' Donuts, in addition to Blue Ridge Barbecue, grab-n-go sandwiches, snacks, salad, and fruit bar.
- **Owens Food Court** at Owens Hall consists of 12 specialty shops serving international and American favorites, including carved-to-order meats, a soup and salad bar, burgers, pastas, Philly cheese steaks, tacos, and a venue that serves exclusively local, organic, or sustainably produced foods.
- **Turner Place** at Lavery Hall offers a variety of convenient options to the academic side of campus. It houses franchises for Jamba Juice, Bruegger's Bagels, and Qdoba Mexican Grill alongside five upscale original venues serving sushi, crepes, gelato, teppanyaki, southern steakhouse fare, sourdough pizza, custom salads, and much more.
- **Vet Med Cafe** at the Virginia-Maryland Regional College of Veterinary Medicine on Duck Pond Drive and offers breakfast and lunch, Monday through Friday. Breakfast features breakfast bagel sandwiches and hot oatmeal, and lunch offers a daily chef special as well as grilled fish tacos and more.
- **West End Market** at Cochrane Hall features wood oven-baked pizzas, wraps, grilled steaks, seafood, homemade pastas, made-from-scratch soups, freshly baked pastries and breads, and more - all prepared right before your eyes.

## Location

The campus is located in Blacksburg, Virginia, about 38 miles southwest of Roanoke, Virginia. To reach the campus from Interstate 81, take Exit 118-B (Christiansburg) onto U.S. Rt. 460 West. To reach the Visitor and Undergraduate Admissions Center, continue on U.S. 460 for 8.5 miles to the Prices Fork Road exit for "Downtown." Turn right at the first traffic light on Prices Fork Road and then take an immediate right and up the drive to the center.

[Detailed Directions to Virginia Tech and Campus Map](#)

## MEDEX Overseas Travel Assistance Program

An overseas emergency travel assistance 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. Some of the services include:

- locating appropriate medical care
- evaluation and close monitoring of treatment - management of emergency medical evacuation and repatriation (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 replacing lost or stolen important travel documents including passports
- multilingual language services in emergency situations
- coordination centers and phone numbers throughout the world

For additional information on MEDEX services contact Risk Management at telephone (540) 231-7439.

## Multicultural Academic Opportunities Program

The Multicultural Academic Opportunities Program (MAOP), founded in 1993 is an academic success community founded upon the principles of self-efficacy, mentoring, and peer support. Central to the goal of

MAOP is the promotion of diversification within the student body of Virginia Tech. Through partnerships with various academic colleges and departments at Virginia Tech, other colleges and universities, governmental entities, and various organizations, MAOP participants are supported with academic guidance, social and emotional support, and financial support.

The MAOP community is open to all students who demonstrate a clear commitment to the pursuit of academic excellence and are interested in the promotion of diversity in an ever global community. MAOP provides opportunities for both undergraduate and graduate students through scholarships, tuition/assistantship support, academic workshops, and undergraduate research opportunities.

Web: <http://www.maop.vt.edu>

Phone: (540) 231-5023

## Parking Regulations

All vehicles, including motorcycles and scooters, parked on the Virginia Tech campus must be registered with the Parking Services Office and must display a university parking permit. Yearly, semester, summer, and daily parking permits are available and an appropriate fee is charged for each permit. Visitors are required to display a visitor permit, which is available at the Virginia Tech Visitor Information Center. For more information about parking or to request a parking regulations handbook, visit [www.parking.vt.edu](http://www.parking.vt.edu) or call (540) 231-3200.

## Alternative Transportation

The Alternative Transportation Program offers several options for commuter students to get to class without the hassles of parking permits and searching for parking spaces through the Commuter Alternatives Program (CAP).

CAP has two programs to fit your commuting needs.

- Carpool Program: Carpooling saves you money on parking and gas, and it's the closest thing you can get to RESERVED PARKING on campus.
- BB&W is available to commuter students who use alternative transportation methods as their primary means of commuting to campus. Examples include riding the Blacksburg Transit or SmartWay buses, bicycling, and walking. By registering for BB&W, you will receive 15 half price daily parking passes.

Bicycles can be registered for free through Parking Services at [www.parking.vt.edu](http://www.parking.vt.edu).

For more information about commuter alternatives visit [www.tcs.vt.edu/alternative](http://www.tcs.vt.edu/alternative) or call (540) 231-0248.

## ROTC Program

The Reserve Officer Training Corps Programs conducted at Virginia Tech are available to cadets and are offered by the Army, Navy/Marine Corps, and the Air Force. All students participating in ROTC are required to be members of the Corps of Cadets. Details about courses offered, as well as available scholarships and stipends, can be found in the department listings under the College of Liberal Arts and Human Sciences; ROTC (Army), ROTC (Navy/Marine Corps), and ROTC (Air Force). Upon successful graduation from Virginia Tech and completion of the ROTC program, the student is commissioned as an officer in either an active or reserve component of the Armed Forces. The total ROTC credits applied toward degree requirements varies by major and ranges from four to 24. All credits count as free electives. Consult your course advisor for information on ROTC credits, which may be used within your major.

Students interested in additional details should contact the professor of military science for Army ROTC, the professor of naval science for Naval/Marine Corps ROTC, or the professor of aerospace studies for the Air Force ROTC program.

## General Rules Governing the Cadet Lifestyle

All Virginia Tech students are eligible to join the Cadet Regiment and participate in the cadet lifestyle. Cadet

student status is a prerequisite for participation in any of the ROTC programs.

**Physical Standards:** The Department of Defense has prescribed physical standards for formal enrollment in the ROTC programs. Cadets not physically qualified for an ROTC program may remain in cadet status as members of the Corps of Cadets.

**Cadet Regulations:** Cadets are expected to adhere to the Cadet Honor Code and abide by all cadet regulations, directives, policies, and procedures of the Corps, as well as the rules governing civilian students.

The following summary gives the prospective cadet an understanding of the nature of his or her obligation as a cadet:

- Cadet officers and non-commissioned officers are responsible to university authorities for the activities of the cadets under their supervision and are given the authority to discharge their responsibilities.
- Cadet residence halls are coeducational with controlled visiting privileges for non-residents and mandatory quiet study periods.
- Alcoholic beverages are prohibited in the cadet residence halls.
- Cadets are required to wear the cadet uniform to classes and cadet functions.
- Cadets are required to live in a designated cadet residence hall unless married and living with a spouse.
- Second-semester freshmen and upperclassmen in the corps may request a change to civilian status at any time. First-semester new cadets may not leave the corps and change to civilian status until the last day to drop a class without penalty (after six weeks of class). All students are encouraged to make status changes (from cadet to civilian lifestyle or vice versa) in conjunction with the beginning or end of an academic semester.

See [Academics](#) section for details on the ROTC course credits which apply toward degrees.

For Additional Information:

<b>Commandant of Cadets</b>	<b>Air Force ROTC</b>	<b>Army ROTC</b>	<b>Naval/Marine Corps ROTC</b>
Lane Hall, Room 141 280 Alumni Mall	Military Building, Room 228 320 Stanger Street	Military Building, Room 228 320 Stanger Street	Femoyer Hall, Room 417 280 Stanger Street
Virginia Tech	Virginia Tech	Virginia Tech	Virginia Tech
Blacksburg, VA 24061	Blacksburg, VA 24061	Blacksburg, VA 24061	Blacksburg, VA 24061
(540) 231-6413	(540) 231-6404	(540) 231-6401	(540) 231-7883
vtcorps@vt.edu	usaf@vt.edu	rotc@vt.edu	usnavy@vt.edu

## Services for Students with Disabilities

Admission to Virginia Tech is based on requirements outlined in the application and in the undergraduate and graduate catalogs. Admission decisions are made without regard to disabilities. All applicants to the university are reviewed through the same admission procedure.

Virginia Tech is committed to ensuring that all qualified individuals with disabilities have the opportunity to take part in educational and employment programs and services on an equal basis. To be eligible for services, students with disabilities must identify themselves and present professional documentation to the Services for Students with Disabilities (SSD) office. Documentation should be recent, relevant, comprehensive, and, where appropriate should contain test scores and interpretation. If the original documentation is incomplete or inadequate to determine the extent of the disability or reasonable accommodations, the university has the discretion to require additional documentation. Any cost incurred in obtaining additional or initial documentation is borne by the student. Until appropriate documentation is provided, the SSD office cannot support the

student's request for services. Faculty members are not expected to provide services unless students present verification of accommodation needs from the SSD office.

## Student Engagement and Campus Life

Through Student Engagement and Campus Life, you can get involved with student organizations, your student unions, leadership development, leisure and recreation, and student employment. This department within the Division of Student Affairs complements the academic experience and enriches the quality of student life at Virginia Tech. Student Engagement and Campus Life cultivates innovative environments and communities to provide transformative experiences for all Hokies. Student learning through engagement and employment are major tenants of our mission. Student Engagement and Campus Life strives to assist students in developing an appreciation for diversity, responsibility for self-learning, critical thinking, and pragmatic skills to become life-long learners, productive citizens, and community leaders.

The department is responsible for the support of our 700+ student organizations as well as the advisement of the Student Budget Board which provides student organization funding, registration, and support for more than 700 student groups.

Student Engagement and Campus Life  
225 Squires Student Center  
Phone: (540) 231-5431  
E-mail: [stuact@vt.edu](mailto:stuact@vt.edu)  
Web: [www.campuslife.vt.edu/student\\_centers/index.html](http://www.campuslife.vt.edu/student_centers/index.html)

**The Black Cultural Center, LGBT Center, Hispanic and Latino Center, and the Multicultural Center** can be found within Squires. This centers hosts educational lectures, programs, and resources celebrating the diversity of the university community.

**Campus Programs** is made up of the offices of Student Organizations and coordinates student organization funding, registration, and support for more than 700 student groups. Campus Programs supports Virginia Tech Union, the largest student programming board, in providing events, activities, and programs for the university community. The Campus Programs office also coordinates all Homecoming activities.

Campus Programs  
225 Squires Student Center  
Phone: (540) 231-1223  
E-mail: [monicah@vt.edu](mailto:monicah@vt.edu)  
Web: [www.vtu.org.vt.edu](http://www.vtu.org.vt.edu)

**Student Organizations** There are more than 700 officially registered student organizations at Virginia Tech. Each student organization has a different focus led by student leaders. All Virginia Tech students are encouraged to find an organization that matches their interests and passions. By using GobblerConnect ([gobblerconnect.vt.edu](http://gobblerconnect.vt.edu)), you can search student organizations to find your fit.

**Event Planning** facilitates and enhances programming for the Virginia Tech community by assisting and consulting in the planning and support of events featured on-campus. The Event Planning Office fosters an educational environment that provides student organization members and departmental representatives with coordination of events, event scheduling, information on liability and risk management issues, standard procedure and protocol, and referrals to Production Services and the Student Engagement and Campus Life Ticket Office.

Event Planning  
221 Squires Student Center  
Phone: (540) 231-5005  
E-mail: [eventplanning@vt.edu](mailto:eventplanning@vt.edu)  
Web: [www.campuslife.vt.edu/eventplanning/index.html](http://www.campuslife.vt.edu/eventplanning/index.html)

**The Information Services Center** in Squires is staffed with knowledgeable students employees who are

ready to answer questions about your student centers, student activities, the university, and the surrounding community. The Information Services Center is where you can learn more about events, get maps and bus schedules, or look for lost and found articles.

The Squires Information Desk  
1st floor Squires lobby  
Phone: (540) 231-6906  
E-mail: [stuact@vt.edu](mailto:stuact@vt.edu)

**The Perspective Gallery** presents art exhibitions by diverse artists working in a variety of media and styles. Visitors can view work of local and regional artists, nationally recognized artists, and artisans from around the world. Receptions and special events allow the public to meet and talk with the artists. Perspective Gallery is located on the second floor of Squires Student Center. Admission is always free. You can also enjoy works in the permanent collection, located throughout the public areas in Squires and Johnston Student Centers and the Graduate Life Center.

Perspective Gallery  
2nd floor Squires Student Center  
Phone: (540) 231-4053  
Web: [www.campuslife.vt.edu/perspectivegallery/index.html](http://www.campuslife.vt.edu/perspectivegallery/index.html)

**The Production Services Office** is a full service production company for campus events. Production Services offers professional lighting, sound, staging, and rigging. The staff works one-on-one with clients to ensure event production expectations are met.

Production Services  
128 Squires Student Center  
Phone: (540) 231-3499  
E-mail: [production.services@vt.edu](mailto:production.services@vt.edu)

**The Recital Salon and Studio Theater**, home for events sponsored by the School of the Performing Arts, are located on the second floor of Squires. Exciting and eclectic concerts and theater performances by students, faculty, and visiting artists are held throughout the year. Contact the Squires Ticket Office or Information Services Center for more information.

**The Student Engagement and Campus Life Ticket Office** is the major ticket distribution center for events other than athletics at Virginia Tech. The office supports ticket sales for theatrical and musical performances, concerts, lectures, and movies.

Student Engagement and Campus Life Ticket Office  
129 Squires Student Center  
Phone: (540) 231-5615 or 800-843-0332  
Web: [www.campuslife.vt.edu/tickets/index.html](http://www.campuslife.vt.edu/tickets/index.html)

**Virginia Tech Off-Campus Housing (VTOCH)**, provides students with resources, programs, and services to assist with their off-campus housing needs including a comprehensive searchable online database. a wonderful resource to begin. VTOCH maintains information on local apartments, realtors, transportation, and issues affecting renters today. VTOCH hosts two housing fairs each year so students can get up close and personal with rental options and roommate fairs so students can make connections with others to share living expenses.

Virginia Tech Off-Campus Housing  
Johnston Student Center, 3rd floor  
E-mail: [vtoch@vt.edu](mailto:vtoch@vt.edu)  
Web: [www.campuslife.vt.edu/vtoch/index.html](http://www.campuslife.vt.edu/vtoch/index.html)

## Recreation

**The BreakZONE Recreation Center** is the place to go to relieve the stress of classes and tests! The

BreakZONE sponsors competitive leagues, on-site skills classes, and open play in a variety of activities. An expanded line-up includes pool tables, bowling lanes, table tennis, foosball, and video games. Students, faculty, staff, and guests can enjoy testing their skills while relaxing with friends in an upbeat environment.. BreakZONE also sells snacks and beverages. Get in the ZONE!

BreakZONE

117 Squires Student Center

Phone: (540) 231-4476

Web: [www.campuslife.vt.edu/breakzone/index.html](http://www.campuslife.vt.edu/breakzone/index.html)

## Student Centers

**Squires** (located off Alumni Mall) and **Johnston Student Centers** (located behind Burruss Hall) are hubs of activity for the university community. They serve as formal and informal meeting places for students, student organizations, and the larger university community. Facilities include meeting rooms, conference rooms, ballrooms, and theaters. Plenty of comfortable space welcomes students. Services such as banking and ATMs can be found in these student centers, as well as a variety of dining options. Many departments call Squires Student Center home. We house the Intercultural Engagement Center, New Student Programs, , the music department, student media, student organization offices, VetZone, a non-denominational meditation space, and Student Legal Services, and numerous cultural centers. Students, faculty, staff, and guests are free to use Squires or Johnston to meet with friends, study, attend activities and events, or just hang out.

Squires Student Center Information Desk

1st Floor Squires Lobby

Phone: (540) 231-6906

Johnston Student Center Information Desk

1st Floor Johnston

Phone: (540) 231-5266

**The Graduate Life Center** at Donaldson Brown (located on Otey Street, across from Squires) is an innovative living-learning facility that supports Virginia Tech's goals for graduate education. The GLC features plenty of study space, a coffee shop, an auditorium, and a multipurpose conference room for graduate and undergraduate students.

GLC Information Desk

1st floor GLC lobby

Phone: (540) 231-0413

**The War Memorial Chapel** stands prominently at the end of the Drillfield. It is the only Chapel on campus and provides a nondenominational place of solitude and meditation for all. It is host to religious services, weddings, baptisms, prayer vigils, memorial services, initiations, military commissioning, music recitals, student vocal and ministry groups, concerts, lectures, individual prayer and meditation, and bible study.

War Memorial Chapel

Phone: (540) 231-6240

## Student Employment

Student Engagement and Campus Life offers a variety of student employment opportunities to compliment your academic pursuits, afford resume-building experience, and provide income. We are committed to the development and advancement of student employees through leadership and career skills training. In all we do, our main goal is to provide customer service to the patrons of our facilities and programs. Join us today and work in YOUR student center!

Student Employment

225 Squires Student Center

Phone: (540) 231-5431

Web: [www.campuslife.vt.edu/employment/students/index.html](http://www.campuslife.vt.edu/employment/students/index.html)

The administrative offices are located on the second floor of Squires Student Center in room 225. The office is open from 8a.m. to 5p.m. Monday through Friday. Please contact us for any information regarding StudentEngagement and Campus Life .

Student Engagement and Campus Life Administrative Office  
225 Squires Student Center  
Phone: (540) 231-5431  
E-mail: [stuact@vt.edu](mailto:stuact@vt.edu)  
Web: [www.campuslife.vt.edu/index.html](http://www.campuslife.vt.edu/index.html)

## Student Health Services and Insurance

### University Student Health Services

University Student Health Services provides general ambulatory health care to students throughout the year. Students who have paid their health fee (included as part of the university's comprehensive fee) and submitted a health history form are eligible for services. A team of physicians, nurse practitioners, physician assistants, certified college health nurses, and licensed practical nurses manages most common illnesses and injuries. X-ray, laboratory, and pharmacy services are available on site.

### Student Medical Insurance Coverage

The university has contracted with an insurance carrier to offer group health coverage for all full-time students at Virginia Tech. For details on levels of coverage and specific limitations, please contact the Student Medical Insurance office at 540/ 231-6226 or visit [www.co.vt.edu/Risk/studenthealthinsr](http://www.co.vt.edu/Risk/studenthealthinsr)

Medical insurance is mandatory for all international students with F-1 or J-1 visas at a minimum of \$500,000 accident and sickness coverage. Medical insurance is mandatory for all College of Veterinary Medicine students. All international students must provide written verification from their insurer that they have equal or better coverage meeting the minimums as set by the University (as outlined on the waiver form and mailed with insurance packets), or they must purchase the university-sponsored plan or another student health insurance plan meeting or exceeding the University outlined minimum levels. Review of insurance policies and completion of the waiver form must be done by the students insurer at the students request. Once the waiver is fully completed by the students insurer the university will determine if the insurance coverage meets the outlined minimum requirements.

### Student Health History

Each student entering Virginia Tech must furnish a health history form, completed by a home physician, for the University Student Health Services. The form will be available online to applicants who accept the offer of admission. Failure to meet Health Services standards may result in dismissal from the university. Information is available at [www.healthcenter.vt.edu](http://www.healthcenter.vt.edu).

## University at a Glance

Since its founding as a land-grant college in 1872, Virginia Tech has grown to an enrollment of about 32,000. With approximately 240 degree programs and managing a research portfolio of more than \$513 million, Virginia Tech offers the widest range of degree choices in Virginia and is the state's leading research institution.

The university offers 90+ bachelor's degree programs through its seven undergraduate academic colleges: the College of Agriculture and Life Sciences, the College of Architecture and Urban Studies, the Pamplin College of Business, the College of Engineering, the College of Liberal Arts and Human Sciences, the College of Natural Resources and Environment, and the College of Science. On the postgraduate level, the university offers about 150 master's and doctoral degree programs through the Graduate School, Virginia-Maryland Regional College of Veterinary Medicine, and the Virginia Tech Carilion School of Medicine.

Dedicated to its motto, *Ut Prosim* (That I May Serve), Virginia Tech takes a hands-on, engaging approach to education, preparing scholars to be leaders in their fields and communities. Undergraduates study under the tutelage of the best minds of the university, and, along with faculty members, are also involved in research projects in fields ranging from biotechnology to urban planning.

Through its focus on teaching and learning, research and discovery, and outreach and engagement, the university creates, conveys, and applies knowledge to expand personal growth and opportunity, advance social and community development, foster economic competitiveness, and improve the quality of life.

In the research arena, seven research institutes have been created to draw upon established strengths and enhance the university's ability to address large-scale research opportunities by crossing traditional disciplinary and college boundaries. These institutes are: the Biocomplexity Institute of Virginia Tech; the Fralin Life Science Institute; Institute for Creativity, Arts, and Technology; Institute for Critical Technology and Applied Science; Institute for Society, Culture, and Environment; Virginia Tech Carilion Research Institute; and Virginia Tech Transportation Institute.

## University Exemplary Departments

University Exemplary Department Awards recognize the work of departments that maintain, through collaborative efforts of dedicated colleagues, exemplary teaching and learning environments for students and faculty.

## University Facilities

Virginia Tech has more than 135 campus buildings, research laboratories, the Corporate Research Center, an airport, 2,600-acre main campus in Blacksburg, and a 1,800-acre research farm in Montgomery County.

Among the university's major facilities in Blacksburg are: Carol M. Newman Library, with more than 2.3 million volumes; the Moss Arts Center, home of the Center for the Arts at Virginia Tech professional presenting program; The Inn at Virginia Tech and Skelton Conference Center, which offers conference space and 147 hotel rooms and suites; Cassell Coliseum (seating 10,000); and Lane Stadium (seating more than 66,000). Adjacent to campus is the Virginia Tech Corporate Research Center, which employs about 2,900 and offers businesses the opportunity to establish close working relationships with the university.

Major facilities outside of Blacksburg include the Center for European Studies and Architecture in Switzerland; the Virginia Tech Northern Virginia Center in Falls Church; the Hotel Roanoke & Conference Center; public radio station WVTF in Roanoke; the Marion duPont Scott Equine Medical Center in Leesburg; Virginia Tech Research Center - Arlington; the Washington-Alexandria Center of the College of Architecture and Urban Studies; the Virginia Tech Carilion School of Medicine and Research Institute; a dozen agricultural experiment stations; and six 4-H centers.

## University Libraries

A member of the prestigious Association of Research Libraries, the University Libraries consist of the Carol M. Newman Library and three branches: Art and Architecture, Veterinary Medicine, and the Northern Virginia Resource Center located in Falls Church, Virginia. Their online services are available 24/7.

The libraries offer services and resources to support students in their work every step of the way. From visiting the Reference Desk on the second floor for help with a research project, to using our [3D printing studio](#) for course projects, to simply using our spaces for quiet our collaborative work, students can find numerous resources at the libraries.

Newman Library is home to many hands-on spaces that allow experiential learning, such as [Fusion Studio](#) for longer term collaborative projects. Students can also seek help with writing papers and other projects at the English department's Writing Center, or assistance preparing for presentations at the communication department's CommLab, both on the second floor.



Help can be found on our [homepage](#), and many resources, including our [Ask A Librarian chat](#), online collections, and [subject research guides](#), can be used from anywhere on or off campus, without stepping foot in our buildings.

In each of the libraries, there is a Circulation and/or Reference desk staffed by people who can help you locate and use resources. Each college and academic department also has a [librarian who is a subject expert](#) and can help you find relevant research, suggest journals, or point you in the direction of resources for your area of study.

Special Collections, located on the first floor of Newman Library, houses major research collections including the Archives of American Aerospace Exploration, the International Archive of Women in Architecture, Railroad Archives, the Culinary History Collection, and many items from the Civil War.

For users with disabilities, there is a Special Services Room in Newman Library equipped with adaptive software and hardware.

For additional information, check out [www.lib.vt.edu](http://www.lib.vt.edu), come walk through our spaces, or stop by one of the help desks.

## Veterans Services

The Office of Veterans Services is the primary resource for Virginia Tech veterans and their dependents. Staff work closely with the Department of Veterans Affairs to receive and process all documentation related to veteran and military student educational benefits. The Office of Veterans Services works closely with The Student Success Center to ensure veterans, military students and dependents are connected to the resources necessary for a successful transition to and through their course of study at Virginia Tech. In collaboration with The Student Success Center, students served by the Office of Veterans Services have access to tutoring, mentoring, assistance navigating the VA system, and the Veterans@VT student organization.

130 Student Services Building (mc 0548)  
Blacksburg, VA 24061  
Phone: (540) 231-5815  
E-mail: [veteran@vt.edu](mailto:veteran@vt.edu)  
Web: [www.veterans.vt.edu](http://www.veterans.vt.edu)



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Governance, Administration, and Faculty

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[Board of Visitors](#)

[Administrative Officers](#)

[Faculty \(A-Z\)](#)

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## Board of Visitors

### Officers

**James L. Chapman, VI**, Rector

**Dennis H. Treacy**, Vice Rector

**Kim O'Rourke**, Secretary

### Members

*Appointed by the Governor to terms expiring on dates indicated.*

*ex officio:* **Steve W. Sturgis**

**James L. Chapman, VI** (2013-17)

**Greta Harris** (2016-20)

**Charles T. Hill** (2015-19)

**Mehmood Kazmi** (2015-19)

**L. Chris Petersen** (2016-20)

**Deborah L. Petrine** (2011-19)

**Michael J. Quillen** (2014-18)

**Wayne H. Robinson** (2014-18)

**J. Thomas Ryan** (2013-17)

**Mehul P. Sanghani** (2014-18)

**Dennis H. Treacy** (2012-20)

**Horacio A. Valeiras** (2014-18)

**Jeffrey E. Veatch** (2016-20)

## Administrative Officers

**Timothy D. Sands**

President

**Thanassis Rikakis**

Executive Vice President and Provost

**John E. Dooley**

Chief Executive Officer of the Virginia Tech Foundation

**Guru Ghosh**

Vice President for Outreach and International Affairs

**Theresa Mayer**

Vice President for Research & Innovation

**Steven H. McKnight**

Vice President and Executive Director of National Capital Region Operations

**Scott Midkiff**

Vice President for Information Technology and Chief Information Officer

**Patricia Perillo**

Vice President for Student Affairs

**Charles D. Phlegar**

Vice President for Advancement

**M. Dwight Shelton, Jr.**

Vice President for Finance and Chief Financial Officer

**Sherwood Wilson**

Vice President for Administration

**Alan Grant**

Dean, College of Agriculture and Life Sciences

**A. Jack Davis**

Dean, College of Architecture and Urban Studies

**Robert Sumichrast**

Dean, Pamplin College of Business

**G. Don Taylor**

Dean, College of Engineering

**Elizabeth Spiller**

Dean, College of Liberal Arts and Human Sciences

**Paul Winstorfer**

Dean, College of Natural Resources and Environment

**Sally C. Morton**

Dean, College of Science

**Cyril Clarke**

Dean, Virginia-Maryland Regional College of Veterinary Medicine

**Paul Knox**

Dean, Honors College

**Tyler Walters**

Dean, University Libraries

**Karen P. DePauw**

Vice President and Dean for Graduate Education

**Charles W. Steger, Jr.**

President Emeritus

## Faculty (A-Z)



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Faculty (A-Z)

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### Footnotes used:

<sup>1</sup> Award for Excellence in Undergraduate Advising

<sup>2</sup> Academy of Teaching Excellence inductee

<sup>3</sup> Wine Award recipient

<sup>4</sup>

<sup>8</sup> Academy of Faculty Service

<sup>9</sup> Commonwealth of Virginia Outstanding Faculty Award

<sup>10</sup> Diggs Teaching Scholar Awards

<sup>11</sup>

Sporn Award recipient

<sup>5</sup> Alumni Award for Extension Excellence

<sup>6</sup> Alumni Award for Research Excellence

<sup>7</sup> Alumni Award for Teaching Excellence

Alumni Award for Excellence in International Education

<sup>12</sup> Alumni Awards for Excellence in International Outreach

<sup>13</sup> Alumni Award for Excellence in International Research

<sup>14</sup> Alumni Award for Outreach Excellence

- The numbers in parentheses indicate the year of joining the faculty. Job title, degrees earned, where obtained, and year obtained follow.
- Non-resident staff locations are noted for those persons not based at the Blacksburg campus.

## A

ABAID, Nicole T. (2012), Asst. Prof. of Biomedical Engineering and Mechanics. B.S., North Carolina, 2003; M.A., Kansas, 2008; Ph.D. Polytechnic Institute of New York, 2012.

ABAYE, A. Ozzie (1992), Prof. of Crop and Soil Environmental Sciences. B.S., Wilson College (PA), 1984; M.S., Penn State, 1987; Ph.D., Virginia Tech, 1992.

ABBAS, Kaja (2011), Asst. Prof. of Infectious Disease in Public Health. MPH, University of Rochester, 2012; PhD, University of North Texas, 2006; MS, University of North Texas, 1999; B.Tech., Indian Institute of Technology, Kharagpur (India), 1997.

ABBAS, Montasir (2005), Assoc. Prof. of Civil and Environmental Engineering. B.S. Univ. of Khartoum (SUDAN), 1993; M.S. Univ. of Nebraska-Lincoln, 1997; Ph.D., Purdue Univ., 2001, P.E.

ABBATE, Janet (2004), Asst. Prof. of Science and Technology in Society. B.A., Harvard-Radcliffe College, 1985; M.A., Univ. of Pennsylvania, 1988; Ph.D., Univ. of Pennsylvania, 1994.

ABBOTT, A. Lynn (1990), Assoc. Prof. of Electrical and Computer Engineering. B.S., Rutgers, 1990; M.S., Stanford, 1981; Ph.D., Illinois, 1989.

ABBOTT, Jonathan A. (2000), Assoc. Prof. of Small Animal Clinical Sciences. D.V.M., Guelph (Canada), 1989; Diplomate, ACVIM (Cardiology).

ABEL, Troy (2010), Asst. Prof. of Art, B.A. Valparaiso Univ., 2004; B.S.F.A. Valparaiso Univ., 2005; M.F.A. Iowa State Univ., 2009; Ph.D. Iowa State Univ., 2010.

ABEYSEKARA, Ananda (1999), Assoc. Prof., Department of Religion and Culture. B.A. Macalester College, 1992; M.A. UVa., 1994; Ph.D, Northwestern Univ., 1999.

ABRAHAMSON, Alan S. (2007), Assoc. Prof. of Business Information Technology. B.S., Cape Town, 1997; Ph.D., Cambridge, 2002.

ABRAHAMSON, Zachary R. (2013), Database & Applications Admin I. B.S., Radford Univ., 2009.

ACHENIE, Luke E.K. (2007), Prof. of Chemical Engineering. B.S., Massachusetts Institute of Technology, 1981; M.S., Northwestern, 1982; M.A.M., Carnegie Mellon, 1984; Ph.D., Carnegie Mellon, 1988.

ADAMS, Colin S. (2015), Asst. Prof. of Aerospace and Ocean Engineering. B.S., Univ. Washington, 2005; M.S. Univ. Washington, 2009; Ph.D. University of New Mexico, 2015.

ADAMS, David R. (2009), Director, Learning Systems Integration and Support. B.S., Missouri State Univ., 1998.

ADAMS, M. Norris (2008), Clinical Asst. Prof. of Surgery and Lameness, Marion duPont Scott Equine Medical Center. B.S., Cornell Univ., 1988; D.V.M., Mississippi State Univ., 1992; Diplomate A.C.V.S., 1999.

ADAMS, Nathan (2014), Visiting Asst. Prof. of Philosophy. B.S., Spring Arbor, 2004; M.A. Virginia Tech, 2008; Ph.D., Washington Univ. in Saint Louis, 2014.

ADAMS, Stephanie G. (2011), Prof. and Head of Engineering Education. B.S., North Carolina A&T State Univ., 1989; M.E., Univ. of Virginia, 1991; Ph.D., Texas A&M Univ., 1998.

ADEL, Gregory T. (1982), Prof. of Mining and Minerals Engineering. B.S., South Dakota School of Mines and Technology, 1978; M.S., South Dakota School of Mines and Technology, 1979; D.Eng., California, Berkeley, 1982.

ADELMAN, Zachary N. (2005), Asst. Prof. of Entomology, B.A., Ithaca College, 1996; Ph.D., Colorado State Univ., 2000.

ADJERID, Slimane (1998), Assoc. Prof. of Mathematics. B.S., Univ. of Algiers, 1979; M.S., Rensselaer Polytechnic Institute, 1982; Ph.D., Rensselaer Polytechnic Institute, 1985.

ADKINS, Emily R. (2014), Lecturer of Mathematics. A.A.S., Virginia Highlands Community College, 2011; B.S., Virginia Tech, 2014.

ADLER, John (2008), Asst. Prof. of Music. B.A., Univ. of Nevada-Reno, 2001; M.M., Univ. of Oregon, 2004.

AFRICA, Emily (2013), Assoc. Director of Recruitment. Pamplin College of Business. B.S. Virginia Tech, 2011.

AGAH, Masoud (2005), Prof. of Electrical and Computer Engineering. B.S in EE, Sharif Univ. of Technology, Tehran, Iran, 1996; BS EE, Sharif Univ. of Technology, 1998; Ph.D., Univ. of Michigan, 2005.

AGMON, Danna (2012), Asst. Prof. of History. B.A., Tel Aviv Univ., 2003; M.A., Univ. of Michigan, 2007; Ph.D., Univ. of Michigan, 2011.

AGNEW, Michael J. (2007), Asst. Prof. of Industrial and Systems Engineering. B.A., Wilfrid Laurier Univ., 2000; M.S., Univ. of Windsor, 2003; Ph.D., Queen's Univ., 2008.

AGOZINO, Onwubiko, (2009), Prof. of Sociology and Africana Studies. B.S., Univ. of Calabar-Nigeria, 1985; M.Phil., Univ. of Cambridge, UK, 1990; Ph.D., Univ. of Edinburgh, 1993.

AGUD, Diane B. (1993), Senior Instructor of Mathematics. B.A., Molloy College, 1985; M.A., St. John's Univ., 1990.<sup>4</sup>

AHMADIAN, Mehdi (1995), Dan Pletta Prof. of Mechanical Engineering. B.S., SUNY, Buffalo, 1980; M.S., SUNY, Buffalo, 1982; Ph.D., SUNY, Buffalo, 1984.

AHMED, S. Ansar (1989), Department Head and Prof. of Biomedical Sciences and Pathobiology. B.Sc., Bangalore (India), 1972; B.V.Sc., UAS (India), 1977; Ph.D., Murdoch U. (Perth, Australia), 1985.

AKERS, R. Michael (1981), Horace E. and Elizabeth F. Alphin Prof. of Dairy Science. A.S., Wytheville CC, 1972; B.S., Virginia Tech, 1974; M.S., Virginia Tech, 1976; Ph.D., Michigan State, 1980.<sup>6</sup>

AL-HAIK, Marwan, S. (2010), Prof. of Biomedical Engineering and Mechanics. B.S., Univ. of Jordan, 1993; M.S., Florida State, 1997; Ph.D., Florida State, 2002.

ALAPLANTE, Rebekah C. (2008), Assoc. Director of Undergraduate Admissions. B.S., Radford Univ., 1999; M.S., Radford Univ., 2001.

ALBRIGHT, Kathryn C. (1994), Chair, Foundation Program in Architecture, Prof. of Architecture. B.Arch., Virginia Tech, 1982; M.Design Studies, Harvard, 1994.

ALEXANDER, Diana Y. (2015), Cost Accounting Manager. B.S., Virginia Tech, 2007; C.P.A.

ALEXANDER, Kathleen A. (2007), Assoc. Prof. of Wildlife Science. B.S., Univ. of California-Davis, 1988; D.V.M., Univ. of California-Davis, 1992; Ph.D., Univ. of California-Davis, 1995.

ALEXANDER, Michael D. (1972), Prof. of Education. B.S., Western Ky., 1966; Ed.D., Indiana, 1969.

ALLEN, Barbara (2000), Prof. of Science and Technology in Society; Assoc. Director of Science and Technology Studies and Director of the Graduate Program in STS, National Capital Region. B.S., Univ. of Colorado, Boulder, 1976; M.S., Columbia, 1977; Ph.D., Rensselaer Polytechnic Institute, 1999.

ALLEN, Katherine R. (1989), Prof. of Human Development. B.S., Univ. of Connecticut, Storrs, 1976; M.A., Syracuse, 1980; Ph.D., Syracuse, 1984.

ALLINGHAM, Liesl A. (2008), Asst. Prof. of German. B.A., Tufts Univ., 1990; M.A., Indiana Univ., 1995; Ph.D., Indiana Univ., 2007.

ALLNUTT, Robin (2002), Senior Instructor of English. B.A., Virginia Tech, 1987; M.F.A., George Mason Univ., 1997.

ALMEDIA, Fabio (2007), Asst. Prof. of Human Nutrition, Foods, and Exercise. B.S.W., Lewis-Clark State College, 2000; M.S.W., Eastern Washington Univ., 2002; Ph.D., Univ. of Denver, 2008.

ALMOND, Lynn A. (2010), Instructor in Accounting and Information Systems. B.S., Virginia Tech, 1977; Master of Accountancy, Virginia Tech, 1988.

ALWANG, Jeffrey R. (1989), Prof. of Agricultural and Applied Economics. B.A., Penn State, 1978; M.S., Penn State, 1985; Ph.D., Cornell, 1987.

AMACHER, Gregory S. (1994), Julian N. Cheatham Prof. of Forest Economics. B.S., Penn State, 1984; M.A., Michigan, 1989; M.A., Michigan, 1990; M.S., Michigan, 1991; Ph.D., Michigan, 1993.

AMATEIS, Patricia G. (1996), Assoc. Prof. of Chemistry. B.S., Concord, 1979; Ph.D., Virginia Tech, 1984.<sup>2,3,4,7</sup>

AMBROSONE, John (2004), Assoc. Prof. of Theatre Arts. B.A., State Univ. of New York at Fredonia, 1983; M.F.A., Virginia Tech, 1986.

AMELINK, Catherine. (2005), Research Analyst and Assessment Coordinator, Engineering. B.A. James Madison Univ., 1997, M.Ed. James Madison Univ., 1998, Ph.D., Virginia Tech, 2005.

ANDERS, Charlotte (1981), Assoc. Director of Program Development, Continuing and Professional Education. B.S., Virginia Tech, 1988; M.S., Virginia Tech, 1991.

ANDERSON, James C. II (2012), Asst. Prof. of Agricultural, Leadership, and Community Education. B.S., Univ. of Illinois, 2000; M.A., Univ. of Delaware, 2003; Ph.D., Univ. of Missouri, 2007.

ANDERSON, Lara B. (2013), Asst. Prof. of Physics. B.S., Utah State Univ., 2003; M.S., Utah State Univ., 2004; Ph.D., Univ. of Oxford, UK, 2008.

ANDERSON, Susan G. (1982), Senior Instructor of Mathematics. B.S., Mary Washington, 1980; M.S., Virginia Tech, 1982.

ANDERSON, T. D. (2011), Asst. Prof. of Entomology, B.S., Wichita State Univ., 1999; MS, Wichita State Univ., 2001; Ph.D., Kansas State Univ., 2006.

ANDRANGO-WALKER, Catalina (2011), Asst. Prof. of Spanish, B.A. Univ. of Missouri-Columbia 2002; M.A. Washington Univ. 2004; PhD. Washington Univ. 2009.

ANGERMEIER, Paul L. (1988), Prof. of Fisheries and Asst. Leader, Coop. Fish and Wildlife Research Unit. B.S., Purdue, 1976; M.S., Illinois, 1979; Ph.D., Illinois, 1982.

ANGERT, Ron (1994), Assoc. Director of Administration for Emergency Preparedness, Division of Student Affairs. B.S., Bluefield College, 1997

ANGINER, Deniz (2012), Asst. Prof. of Finance. B.Comm., Univ. of Toronto, 2000; M.A., Univ. of Toronto, 2001; Ph.D., Univ. of Michigan, 2010.

ANING, Alexander O. (1992), Assoc. Prof. of Materials Science and Engineering. B.S., Morgan State Univ., 1976; Ph.D., Univ. of Missouri-Rolla, 1982.

ANSELL, Aaron (2012), Asst. Prof., Dept. of Religion and Culture. B.A., Univ. of California San Diego, 1999; M.A., Univ. of Chicago, 2002; Ph.D., Univ. of Chicago, 2007.

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## B

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DRESSER, Zachary (2013), Visiting Asst. Prof., Dept. of Religion and Culture. B.A., Emory and Henry College, 2005; M.A., Yale Univ., 2008; M.A., Rice Univ., 2010; Ph.D., Rice Univ., 2013.

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DU, Pang (2006), Asst. Prof. of Statistics. B.S., Univ. of Sci. & Tech. of China, 1996; M.S. Univ. of Sci. & Tech of China, 1999; M.A. and MS.E., Johns Hopkins Univ., 2002; M.S., Purdue Univ., 2003; Ph.D., Purdue Univ., 2006.

DUBINSKY, James (1998), Assoc. Prof. of English. B.A., Wake Forest Univ., 1977; M.A., Univ. of California at Berkeley, 1986; Ph.D., Miami Univ. of Ohio, 1998.<sup>10</sup>

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WYATT, Christopher L. (2002), Assoc. Prof. of Electrical and Computer Engineering. B.S., Univ. of North Carolina at Charlotte, 1997; Ph.D., Wake Forest Univ. School of Medicine, 2002.

WYNNE, Randolph H. (1996), Assoc. Prof. of Forestry. B.S., North Carolina-Chapel Hill, 1986; M.S., Wisconsin-Madison, 1993; Ph.D., Wisconsin-Madison, 1995.

## X

XIA, Kang (2011), Assoc. Prof. of Crop and Soil Environmental Sciences. B.S., Beijing Agricultural Univ., 1989; M.S., Louisiana State Univ., 1993; Ph.D., Univ. of Wisconsin-Madison, 1997.

XIANG, Zheng (2013), Asst. Prof. of Hospitality and Tourism Management. B.A., Xi'An Jiaotong Univ., 1988; M.S., Univ. of Illinois at Urbana-Champaign, 2004; Ph.D., Temple University, 2008.

XIAO, Heng. (2012), Asst. Prof. of Aerospace and Ocean Engineering. B.S., Zhejiang Univ., China. 2003, M.S., Royal Institute of Technology (KTH), Sweden (2005), Ph.D., Princeton Univ., USA (2009)

XIAO, Shuhai (2003), Prof. of Geobiology. B.Sc., Beijing Univ., 1988; M.Sc., Beijing Univ., 1991; A.M., Harvard Univ., 1996; Ph.D., Harvard Univ., 1998.

XIN, Hongliang (2014), Asst. Prof. of Chemical Engineering. B.S., Tianjin Univ., 2002; M.S., Tsinghua Univ. 2005; Ph.D., Univ. of Michigan, 2011.

XU, Bin (2011), Asst. Prof. of Biochemistry. B.Sc., Fudan Univ., 1989; M.Sc., Fudan Univ., 1992; Ph.D., Case Western Reserve, 2004.

XU, Jin (2014), Asst. Prof. of Finance. B.A., Renmin Univ., 1999; M.A., Peking Univ., 2002; M.B.A., Univ. of Chicago, 2006; Ph.D., Univ. of Chicago, 2007.

XU, Yong (2004), Assoc. Prof. of Electrical and Computer Engineering. B.S., Applied Physics, Tsinghua, 1995; Ph.D., Physics, California Institute of Technology, 2001.

XUAN, Jianhua (2006), Prof. of Electrical and Computer Engineering, B.S., Univ. of Zhejiang, 1985; M.S., Univ. of Zhejiang, 1988; Ph.D., Univ. of Zhejiang, 1991; Ph.D., Univ. of Maryland, 1997. (Northern Virginia Campus)

## Y

YANG, Yaling (2006), Assoc. Prof. of Electrical and Computer Engineering. B.S., Univ. of Electronic Science and Technology of China, 1999; Ph.D., Univ. of Illinois, 2006.

YANG, Zhaomin (2002), Assoc. Prof. of Microbiology. B.Sc., Peking Univ. 1985; M.Sc. Univ. of California, Davis, 1993; Ph.D., Univ. of California, Davis, 1996.

YANG, Zhou (2007), Asst. Prof. of Economics. Ph.D., Univ. of Michigan, 2007.

YAO, Danfeng (2010), Assoc. Prof. of Computer Science. B.S., Peking Univ., 1998; M.A., Princeton Univ., 2000; M.S., Indiana Univ., 2002; Ph.D., Brown Univ., 2007.

YEE, Gordon T. (2001), Assoc. Prof. of Chemistry. B.S., Univ. of California (Berkeley), 1983; Ph.D., Stanford, 1990.

YIANILOS, Christopher J. (2009), Executive Director of Government Relations, B.A., VPI&SU, 1994; J.D., Washington & Lee University School of Law, 1997.

YODER, Keith S. (1976), Prof. of Plant Pathology. B.A., Goshen, 1968; M.S., Michigan State Univ., 1972; Ph.D., Michigan State Univ., 1974 (Alson H. Smith Agricultural Research and Extension Center).

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YOU, Wen (2006), Asst. Prof. of Agricultural and Applied Economics. B.A., Nankai Univ., 2000; Ph.D., Texas A&M Univ., 2005.

YOUNG, Anne L. (1995), Director, Alumni Relations. B.S., Virginia Tech, 1989; M.A., Virginia Tech, 1995.

YOUNG, Kevin D. (2012), Asst. Prof. of Practice of Civil and Environmental Engineering. B.S., Virginia Tech, 2000; M.S., Virginia Tech, 2006; P.E.

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ZAWISTOWSKI, Marie (2008), Asst. Prof. of Practice. M.Arch., Ecole d'Architecture, Paris, Malaquais., 2004.

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ZHANG, Bo (2013), Research Assistant Prof., Soybean Genetics and Breeding Specialist. B.S., Shenyang Agricultural Univ., 1998; M.S., Chinese Academy of Agricultural Sciences, 2003; Ph.D, Univ. of Arkansas, 2006.

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ZHANG, Yi-Heng Percival (2005), Prof. of Biological Systems Engineering. B.E., East China Univ. of Science and Technology, 1993; M.S., East China Univ. of Science and Technology, 1996; Ph.D., Dartmouth, 2002.

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# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Honors College

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- 

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## University Honors

The mission of University Honors is to inspire and facilitate an extraordinary education for students of exceptional motivation and ability who seek to be active learners and who will apply their knowledge and skills to critical real-world problems. To this end, University Honors provides opportunities and challenges founded on five critical experiences: meaningful and sustained relationships with faculty, independent learning, undergraduate research, place-based and problem-focused experiences, and intellectual engagement in global contexts. Honors curricula are designed to maximize the disciplinary depth, interdisciplinary capacities, and purpose-driven engagement that are the hallmarks of the Virginia Tech undergraduate student experience and the VT-Shaped Student.

## Participation

Entering freshmen are encouraged to apply to University Honors if they have a cumulative GPA of 3.80 (as reported on their high school transcript) and a minimum SAT score of 1350 (critical reading and mathematics) or a minimum ACT composite score of 30. Students who do not meet these criteria but feel an exception should be made are able to apply. We expect that the other components of the application (extracurricular, honors, awards, publications, etc.) will off-set the lower quantitative scores. Transfer students and continuing Virginia Tech students who achieve a GPA of 3.60 or greater are invited to apply. Students remain in the program on the basis of their continued high academic performance and the pursuit of one of six honors diplomas.

## Course Selection

Course selection is not necessarily tied to the student's major field of study.

Honors students may participate in honors reading groups, honors colloquia, and honors sections of regular courses. Honors sections of regular academic courses often are offered in biology, political science, history, economics, chemistry, English, mathematics, and psychology. Occasionally, honors sections are offered in other subject areas as well. Departmental honors courses are managed directly by the respective departments.

## Honors Diplomas

An honors diploma is a designation to the undergraduate diploma. One University Honors diploma would not suffice at a University such as Virginia Tech. We have created six Honors options for the students eligible for Honors.

Diploma	Description
Commonwealth Scholar	Considered to be a viable diploma option for transfer students entering University Honors late in their college career.
Scholar in Health Studies	Created for students desiring to enter a career in a health related field gained in connection with the minor in Medicine and Society.
Honors Scholar	The baseline diploma for Honors students who do not complete an Honors thesis.
In Honors	For students desiring to enter graduate school or professional school immediately following graduation and are interested in undergraduate research. Thesis required.
Honors Baccalaureate	The most rigorous diploma available to University Honors students. Designed to prepare students for graduate or professional school immediately following graduation. Thesis required.
Honors Global Scholar	Created for students with a global engagement.

Throughout the course of an Honors student's career, there are several benchmarks for obtaining the various diplomas. Following the freshman year, students declare their diploma intention. Progress towards the diploma is reported annually. As a senior, University Honors students order their honors diplomas.

## Graduation Requirements

- University Honors students must maintain a cumulative grade point average of 3.50 or higher.
- University Honors students must meet all the requirements determined by the department of the major(s) and college(s) conferring the degree(s).
- University Honors students must complete all requirements for their anticipated Honors diploma(s).

## Honors Advising

A primary function of the University Honors staff is to assist students in mapping an Honors diploma that is attainable in conjunction with their departmental degree(s).

Additionally, departmental Honors Advisors work specifically with University Honors students. These departmental Honors Advisors act as an extension of the University Honors office to help students with exceptional advanced opportunities within their chosen field of study. Departmental Honors advisors should be contacted when specific questions arise related to the completion of degree(s).

Advising for major national scholarships like Rhodes, Marshall, and Fulbright Scholarships are available through University Honors for all Virginia Tech students.

## Honors Communities

There are opportunities for Honors students to become part of one of the Honors communities: Hillcrest Hall and the Honors Residential College (HRC).

The Hillcrest community is home to 101 students and is housed in Hillcrest Hall. The Honors Residential

College is located in East Ambler Johnson Hall and is home to approximately 320 students along with Faculty Principals in residence. Both communities are composed of students from all majors and levels, freshmen through seniors.

While students are encouraged to apply for the communities, Honors residence is not a requirement to be a University Honors student. Many honors students also reside in other Living Learning Communities offered throughout the University.

## Undergraduate Course Descriptions (UH)

### 1004: TOPICS FIRST-YEAR HONORS SEM

A course for first-year University Honors students that is facilitated by students and faculty. Introduces students to the scope, nature, and requirements of University Honors and opportunities as a Virginia Tech student. First-year residents of Hillcrest Community and Honors Residential College required to participate. Optional for first-year non-house students. Fall semester only. Variable course content. May not be repeated.

Pass/Fail only.

(1H,1C)

### 2004: CAREERS IN MEDICINE

This class is designed to help students thinking of a career in healthcare investigate some of the many professional tracts and careers available. Representatives from some of the professional schools and professionals will present different career paths that are available to students interested in health care. The class will also cover some of the issues in biomedical ethics, health policy, how to prepare for admission test (such as MCAT, DAT, etc.) how to finance professional school, and the "nuts and bolts" of the application process.

(1H,1C)

### 2104: TOPICS IN HONORS HOUSE SEMINAR

Reading based sections within the honors houses in which small groups of students work toward two goals: the practice of discussion, debate, and argumentation; and the art of community building. Honors house members only. Variable course content. Repeatable for up to six credits.

Pass/Fail only.

(1H,1C)

### 2124: HONORS READING SEMINAR

Reading based sections in which small groups of students practice discussion, debate, and argumentation grounded in a topic or genre of reading of their group's choosing. Sophomore honors standing. Variable course content. Repeatable for up to six credits.

Pass/Fail only.

(1H,1C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3004: TOPICS HONORS COLLOQUIA SERIES

Brings Honors students together with distinguished faculty on special topics of mutual interest. Varied, often interdisciplinary topics. Conversational and participatory. Sophomore honors standing. Variable course content. Repeatable for up to six credits.

Variable credit course.

### 3014: TOPICS HONORS STDNT COLLOQUIUM

A course designed to draw together students with a very knowledgeable student facilitator on special topics of mutual interest under the guidance of a faculty co-facilitator. Some topics are broad and interdisciplinary while others explore a single topic in depth. Open to all Honors students. Sophomore

Honors standing required. Variable course content. Repeatable for up to six credits.  
(3H,3C)

#### 3204: HONORS SERVICE LEARNING

A two-part course. Part one: three hours a week working directly with community partners. Part two: a one-hour class to reflect on the service experience and discuss readings and other course materials that place the experiential learning into a theoretical context. Open to all Honors students. Variable course content. Repeatable for up to six credits.

(1H,6L,3C)

#### 3954: STUDY ABROAD

Honors Section.

Variable credit course.

#### 4004: HONORS TUTORIAL

Small, seminar-style course of one or a few students. Students explore a specific topic that is new to them with a faculty member who provides individual attention and is an expert in that established field. Open to all Honors students. Junior Honors standing. Variable course content. Repeatable for up to six credits.

(1H,6L,3C)

#### 4104: HONORS STUDENT TEACH PRACTICUM

For Honors students facilitating Honors courses that encourage and require student facilitation or mentorship responsibilities. Student Teaching Assistants and their sections are overseen by honors faculty or staff. Student Teaching Assistants meet weekly with a member of the honors staff in a class designed to prepare them for the facilitation experience and to monitor their progress. Open to all Honors students, subject to Program approval. Sophomore Honors standing required. Variable course content. Repeatable for up to six credits.

Pass/Fail only.

(1H,2L,2C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



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## University Academic Advising Center

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## University Academic Advising Center

The University Academic Advising Center serves the university community in several ways. First, it administers the University Studies program for new undergraduate students who want to explore a variety of degree programs before they commit to one particular major. Students who enter Virginia Tech as University Studies students are not limited to pursuing a specific major in their first year. With the guidance of a professional academic advisor students research the full range of degree programs related to their interests and design programs of study that meet graduation requirements while providing the academic flexibility to pursue whichever degree program they ultimately choose. Second, the Advising Center assists new students who intend to reapply to competitive admission majors. Advisors work with these students in developing programs of study that meet the established criteria for admission into to their chosen major. For both of these student populations the University Academic Advising Center serves as both the college and department, providing administrative services, dean's office services, and academic advising until the students enter a specific major.

## University Studies

University Studies is a major but it is not a degree program. University Studies offers a structured advising program that provides students with the necessary support and strategies to investigate and compare academic disciplines so that they can make informed decisions about the degree programs they will pursue. Students can explore any major available at the university while completing course requirements toward a baccalaureate degree. To ensure that students graduate in a timely manner, University Studies requires all students to enter a specific degree program by the time they have earned 60 credits toward graduation (approximately the end of the sophomore year) or have attempted 72 hours.

## Restricted Majors

University Studies students can pursue any major offered at the university; however, students should be aware that some majors are competitive for internal transfer. These programs have established specific criteria and application procedures that students must fulfill in order to be considered for internal transfer into the major. In general, these criteria require students to demonstrate proficiency in designated core courses and, for some programs, in introductory major courses before they are eligible to apply.



University Studies students enter and graduate from these restricted programs each year; however, since there is no guarantee of acceptance to these programs, students are encouraged to investigate alternative majors even as they prepare to enter a restricted program.

## Restricted Programs for Internal Transfers

### College of Agriculture and Life Sciences

Human Nutrition, Foods and Exercise

### College of Architecture and Urban Studies

Architecture

Art and Art History - Visual Communication Design; Studio Art

Industrial Design

Interior Design

Landscape Architecture

Minor: Industrial Design

### Pamplin College of Business

Accounting and Information Systems

Business Information Technology

Finance, Ins. & Business Law

Hospitality and Tourism Management

Management

Marketing

Minor: Business

### College of Engineering

All majors

### College of Science

Biological Sciences

Academic advisors in the University Academic Advising Center are familiar with the internal transfer criteria and procedures for all restricted programs and will assist students in fulfilling these requirements.

## General Education - Curriculum for Liberal Education (CLE)

All undergraduate students at the university, regardless of their majors, are required to fulfill general education course requirements in English, mathematics, science, social science, humanities, etc. There is a standard set of these courses, the Curriculum for Liberal Education (CLE), that all degree programs incorporate in their graduation requirements.

In general, CLE requirements are completed in the freshman and sophomore years. Some majors are flexible with regard to which CLE courses can be used to fulfill degree requirements; other majors designate specific CLE course selections. Academic advisors assist University Studies students in selecting courses that apply toward as many of the majors a student is considering as possible. Thus, students fulfill degree requirements for graduation while they are exploring majors and are usually able to graduate on time.

Typical First Year Program	
First Semester	Second Semester
First-Year Writing	First-Year Writing
Mathematics	Mathematics

Natural Science (lab-if required by intended major)	Natural Science (lab-if required by intended major)
Social Science	Social Science
Humanities/Elective	Humanities/Elective/Major Specific Course

For University Studies students, as for most students at the university, the first year is primarily devoted to fulfilling Curriculum for Liberal Education requirements. Of course, University Studies' students' programs of study vary depending upon the major or majors they are considering. Specific course selections are determined in individual consultation with an academic advisor.

## Graduation Requirements

The requirements to graduate in a specific major are determined by the department and college conferring the degree. In general, students are required to have a minimum 2.0 overall grade-point average and a minimum 2.0 grade-point average in their major in order to graduate. The number of credit hours required for a baccalaureate degree varies from 120 to 136 hours, depending upon a student's major and degree program.

## Honors College

Anyone applying to the university may apply to University Honors. There are no minimum scores that a student must meet in order to apply. For freshmen who entered University Honors in Fall 2014, the average GPA was 4.24 (with a range of 3.51 – 5.00), the average (Math + Verbal) SAT was 1353 (with a range of 1020 – 1600), and the average ACT composite score was between a 30 and a 31 (with a range of 19 – 36). Our application looks holistically at an applicant's experiences and considers the quality of engagement over sheer quantity, self-awareness and reflection on involvement, and authenticity.

Students who do not enter Virginia Tech in Honors will have an opportunity to apply to University Honors after they have established themselves at the university and met the internal GPA requirement.

## Dean's List

University Academic Advising Center students who demonstrate academic excellence are named to the Academic Dean's List and are awarded a Dean's List certificate. Students must be enrolled in a minimum of 12 graded hours (A-F) and must achieve a 3.4 GPA or higher in the fall or spring term to qualify.

## Pre-Professional Advising

Students who want to enter professional schools but who have not yet chosen an undergraduate major will find that the university offers a variety of degree programs that provide excellent preparation for advanced training in professional fields. Though some professional programs, such as medicine, dentistry, and veterinary medicine, require students to complete a minimum number of credit hours at the undergraduate level in chemistry, biology, mathematics, etc., professional schools do not dictate that students pursue specific undergraduate majors. Some examples of undergraduate majors that are frequently chosen as preparation for professional training appear below, but a student can pursue almost any undergraduate degree and be competitive for admission to a professional program.

## Global Education Office (Study Abroad)

Opportunities to study at institutions in other countries are available to all qualified students, regardless of their major. Study abroad offers students a unique opportunity to learn about other cultures and peoples

while earning college credit. Students who intend to participate in an overseas study experience should discuss their intentions with their advisor early in their academic career.

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## Publication and Contractual Information

The provisions of this catalog do not constitute a contract, expressed or implied, between any applicant or student and Virginia Polytechnic Institute and State University. The university reserves the right to change any of the provisions, schedules, programs, courses, rules, regulations, or fees whenever university authorities deem it expedient to do so.

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Information about [campus and workplace violence prevention](#) is available online. Individuals with questions or concerns about Policy 1025, any of these regulations, or related issues should contact:

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Senior Associate Vice President for Student Affairs  
Interim Title IX Coordinator  
Office of Student Programs  
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Phone: (540) 231-8064

# Policy Statement on Sexual Harassment

Sexual harassment is considered to be a form of discrimination based on sex and falls within the statutory prohibitions against sex discrimination. The university is committed to maintaining a working and a study environment free of sexual harassment. Accordingly, in compliance with Section 703 of Title VII of the Civil Rights Act of 1964 and Title IX of the Education Amendments of 1972, it is the university's policy not to tolerate any verbal, nonverbal, or physical behavior which constitutes sexual harassment. Personnel with supervisory responsibilities are required to take immediate and appropriate action when incidents of alleged sexual harassment are brought to their attention. Violations of the policy prohibiting sexual harassment may lead to disciplinary actions, including reprimand, suspension, or termination of employment or academic status.

Sexual harassment is defined as unwelcome sexual advances, request for sexual favors, and other verbal, nonverbal, or physical conduct of a sexual nature when:

- submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment or academic decisions, or
- submission to or rejection of such conduct by an individual is used as the basis for employment or academic decisions, or
- such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment.

Faculty, staff, students, and applicants for employment or admission with complaints of sexual harassment should contact the University EO/AA Office on a confidential basis and request an informal investigation.

Faculty, staff, and students may file formal complaints outside the university. Students may file formal complaints with the Office of Civil Rights of the Department of Education. Faculty may file formal complaints with the Equal Employment Opportunity Commission. Staff may contact the State EEO Office or the Equal Employment Opportunity Commission.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## College of Agriculture & Life Sciences

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[Plant Pathology, Physiology, and Weed Science](#)

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**Dean:** Alan Grant

**Associate Dean & Director of Academic Programs:** Susan S. Sumner

**Associate Dean & Director of Virginia Agricultural Experiment Station:** Saied Mostaghimi

**Dean & Director of Virginia Cooperative Extension:** Ed Jones

**Director of Agricultural Technology:** Pavli Mykerezzi

Web: [www.cals.vt.edu](http://www.cals.vt.edu)



## Mission

The college creates, integrates, and shares knowledge to enhance:

- Life sciences, food, and agricultural systems
- The economic prosperity and life quality of the greater community
- The stewardship and health of land, water, and air for future generations
- Student learning through diverse, hands-on, experiential opportunities

## Vision

We address current and emerging issues in agricultural and life sciences by building on the land-grant commitment of developing leaders and creating and sharing knowledge through diverse, hands-on applications.

## Values

The College of Agriculture and Life Sciences embraces the following core values:

- Freedom of inquiry
- Mutual respect
- Lifelong learning

- A commitment to diverse and inclusive communities
- *Ut Prosim* (That I May Serve)
- Personal and institutional integrity
- A culture of continuous improvement
- Integrated scholarship across the land-grant missions
- International engagement
- Interdisciplinary collaboration

## Undergraduate Programs

The undergraduate program in the college is organized into majors designed for students with widely different interests. These majors permit the student to achieve a satisfactory degree of specialization while providing the fundamentals necessary for continuing professional growth after graduation.

Freshman students may enter the college with the designation LFSC (Life Sciences, Undecided). Upon completion of the freshman year, a college major should be selected.

Students who plan to transfer to Virginia Tech and major in the College of Agriculture and Life Sciences after two years of community or junior college enrollment are encouraged to complete as many of the curriculum for liberal education courses as possible before they transfer.

### Undergraduate Majors Offered:

- Agribusiness
- Agricultural Sciences
- Agricultural Technology (associate degree)
- Animal and Poultry Sciences
- Applied Economic Management
- Biochemistry
- Crop and Soil Environmental Sciences
- Dairy Science
- Environmental Horticulture
- Environmental Science
- Food Science and Technology
- Human Nutrition, Foods and Exercise
- Landscape Horticulture and Design

### Minors Offered:

- Agribusiness Management
- Agricultural and Applied Economics
- Animal and Poultry Sciences
- Civic Agriculture and Food Systems
- Crop and Soil Environmental Sciences
- Dairy Science
- Entomology
- Environmental Economics, Management and Policy
- Environmental Science
- Equine Science
- Food Science and Technology
- Horticulture
- International Agricultural and Life Sciences
- International Trade and Development



- Leadership and Social Change
- Plant Health Sciences
- Turfgrass Management
- Wetland Science
- Viticulture

### Learning Communities

- Residential Leadership Community
- Da Vinci - The Biological and Life Sciences Learning Community

## College-wide Minors

The college offers two interdisciplinary minors: Civic Agriculture and Food Systems (CAFS) and International Agricultural and Life Sciences (IAG). A cross-campus team of faculty, staff, students, and community partners collaborated to develop an undergraduate curriculum for a transdisciplinary and experiential-based Civic Agriculture and Food Systems (CAFS) minor. This minor provides students with knowledge and skills to identify, examine, and integrate agriculture and food system sustainability philosophies and activities into personal and professional practice.

The framework for the curriculum was developed around knowledge and core values that embody the definition of CAFS:

- food security/sovereignty
- civic engagement/democratic participation
- strong local economies
- healthy people/communities
- collaborative teaching and experiential learning

Reflecting a growing trend in higher education, the CAFS minor embodies a commitment to developing and strengthening an economically, environmentally, and socially sustainable system of agriculture and food systems that relies on local resources and serves local markets and citizens. What makes this minor unique is its commitment to serving the needs of all students using transdisciplinary approaches to curriculum development, collaborative teaching strategies, and experiential learning. It is designed to promote academic enhancement, personal growth, and civic engagement while strengthening the student's capacity to learn about civic agriculture and food systems through reflection and experiential practice to solve "real-world" problems.

The minor in International Agricultural and Life Sciences focuses on agricultural issues as they apply to less developed countries. The courses recommended for the minor deal with problems affecting these countries, such as environmental degradation, competition for resources, food security, and economic stability, as well as the role of agriculture in finding solutions to alleviate these problems.

## Pre-Professional Advising

Each year over 45% of our students are admitted to a professional school. Pre-health advising (e.g. pre-dentistry, pre-medicine, and pre-veterinary) is coordinated through the Office of Health Professions located in Career Services.

## Honor Societies

**Gamma Sigma Delta** - Gamma Sigma Delta is an organization having as its objectives the advancement of agriculture in all its phases, the maintenance and improvement of the relations of agriculture and related sciences to other industries, and the recognition of the responsibilities of those engaged in all aspects of agriculture to humankind. Our Society seeks to encourage high standards of scholarship and worthy achievements in all branches of the agricultural and related sciences as well as a high degree of

excellence in the practice of agricultural pursuits.

**Phi Kappa Phi** - Phi Kappa Phi has chapters on nearly 300 select college and university campuses in North America and the Philippines. Membership is by invitation only to the top 10 percent of seniors and graduate students and 7.5 percent of juniors. Faculty, professional staff, and alumni who have achieved scholarly distinction also qualify. The Society's mission is "To recognize and promote academic excellence in all fields of higher education and to engage the community of scholars in service to others."

**Phi Beta Kappa** - Phi Beta Kappa is the oldest and most prestigious honor society dedicated to recognizing excellence in the liberal arts and sciences. Students in the College of Agriculture and Life Sciences who have exhibited outstanding academic ability in eligible coursework may be eligible for selection to Phi Beta Kappa.

## Scholarships

College and departmental scholarships are available for students enrolled in the College of Agriculture and Life Sciences. Descriptions and deadlines are available on the Scholarships and Financial Aid website.

## Undergraduate Research

Research opportunities and experiencing the excitement of discovery can play an important part in undergraduate training in science. College of Agriculture and Life Sciences departments offer diverse research opportunities in which students may choose to participate. Individuals interested in undergraduate research should contact faculty members in the departments where they wish to conduct research.

## International Study Opportunities

The Academic Programs Office in the college, in cooperation with the Office of International Research and Development, offers several avenues for students both in and outside the college to gain international knowledge and experience. These study opportunities allow students and faculty to become aware of and develop basic knowledge of food, fiber, and environmental issues in the world. Specific activities include study abroad programs and courses, international internships, formal student exchange programs, seminars and workshops on campus, and courses in the college which focus on international topics. In addition, the minor in International Agriculture is available which involves selecting 18 credit hours of study from a selected list of courses. Students wishing to explore this minor should contact the Office of Academic Programs in the college. All of the departments in the college offer education abroad opportunities and students wishing to explore these opportunities should contact the coordinating advisor in their department.

## Career Advising

Career advising is available from a number of sources. The university offers centralized career services and on-campus interviewing. The College of Agriculture and Life Sciences works with employers interested in hiring students with degrees from the college and organizes employer panels and information sessions. Every major has a departmental career advisor who specializes in guiding students from their field towards career success.

Career Services offers each student a FREE Hokies4Hire account. Undergraduate students who are seeking any type of career-related employment, including internships, co-ops, career-related summer employment, and permanent positions are eligible to use Hokies4Hire. You may upload your resume and apply for jobs in Hokies4Hire. These include jobs with on-campus interviews as well as job postings. Additional information may be found at [www.career.vt.edu/H4H-OCI/H4HIndex.html](http://www.career.vt.edu/H4H-OCI/H4HIndex.html).

# Internship, Co-op Opportunities and Enrichment Programs

Students are encouraged to participate in internship and co-op opportunities to gain relevant work experience prior to graduation. Departmental career advisors can help students identify opportunities. In some cases, students can receive credit for qualifying work experience. Enrichment studies include field station opportunities, study abroad and summer laboratory experiences outside the university.

## Graduate Programs

All College of Agriculture and Life Sciences departments offer graduate degrees at both the Master's and Ph.D. levels. Complete information on these programs including descriptions of graduate courses can be found in the [Graduate Catalog](#).

## Undergraduate Course Descriptions (ALS)

### 1004: AGRICULTURE, THE ARTS AND SOCIETY

Introduction to the relationships among agriculture, society, and the arts, all of which are integral components of civilization. Pass/Fail only. (1H,1C)

### 1234: CALS FIRST YEAR SEMINAR

Exploration of topics related to the College of Agriculture and Life Sciences (CALS) from a multidisciplinary perspective with a focus on communication and teamwork, problem-solving, inquiry, and integration. Students explore resources to promote academic success, investigate careers and academic areas, and develop a comprehensive plan of study. Freshman and transfer students only. (1H,1C)

### 2204: INTRODUCTION TO CIVIC AGRICULTURE

Introduction to the economic, social, and ecological foundations of civic agriculture. Topics include industrialization, localized food systems, and citizen participation in civic agriculture. Emphasis will be given to a range of civic agriculture models, strategies, and hands-on approaches to establish, retain and strengthen community-based food and agriculture systems. (3H,3C)

### 2304: COMPARATIVE ANIMAL PHYSIOLOGY AND ANATOMY

Comparative anatomy and physiology of domestic mammals and birds including cell neural, musculoskeletal, respiratory, cardiovascular, urinary, and endocrine systems. Pre: BIOL 1106. (3H,2L,4C)

### 2404 (BIOL 2404): BIOTECHNOLOGY IN A GLOBAL SOCIETY

Introduction to the world-wide impact of biotechnology and molecular biology, including applications to plants, animals, and microorganisms. Explores basic concepts of genetic engineering, scientific and ethical issues, and public concerns related to biotechnology. Topics include: environmental release of genetically engineering organisms, bioremediation, safety of genetically engineered food products, transgenic plants and animals, gene therapy, and genetic screening. Pre: (BIOL 1015, BIOL 1016) or (BIOL 1105, BIOL 1106) or (BIOL 1205H, BIOL 1206H), (C HEM 1015, CHEM 1016). (3H,3C)

### 2504: ANIMALS IN SOCIETY

Overview of animal well-being and behavior, human-animal interactions, responsibilities to animals, animal care, behavior, disease and pain recognition and current topics concerning companion animals, domestic animals and wildlife. (2H,3L,3C)

### 2964: FIELD STUDY

Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

**3104: ANIMAL BREEDING AND GENETICS**

Principles of genetics related to improvement of domestic farm animals. Molecular, cellular and physiological genetics, estimation of breeding values, selection, heritabilities, genetic correlations, relationships, in-breeding, heterosis, genetic abnormalities. Pre: BIOL 1105, STAT 2004. (2H,2L,3C)

**3204: ANIMAL NUTRITION AND FEEDING**

Characteristics, sources, digestion, absorption, and metabolism of water, carbohydrates, lipids, proteins, vitamins, and minerals. Feeding systems for livestock, poultry and companion animals. Pre: 2304, (CHEM 1036 or CHEM 1036H or CHEM 1016). (3H,3C)

**3304: PHYSIOLOGY OF REPRODUCTION**

Physiological mechanisms that control and affect reproductive processes in domestic species. Investigation of the anatomy and physiology of the reproductive systems from cellular to whole-body levels with a particular emphasis on implications for reproductive function. Pre: 2304. (2H,2C)

**3314: PHYSIOLOGY OF REPRODUCTION LAB**

Investigation of the structure and function of reproductive systems of domestic species. Practical application of this knowledge is then taught through demonstrations, hands-on experiences and assignments exploring current farm-animal production systems. Co: 3304. (3L,1C)

**3404: ECOLOGICAL AGRICULTURE: THEORY AND PRACTICE**

Presents an overview of historic and modern agricultural practices. Surveys the principles of ecology in the context of managed ecosystems, civic agriculture, and food systems. Explores ecologically based practices and their use in holistic and integrated agricultural systems. Pre: 2204. (2H,3L,3C)

**3954: STUDY ABROAD**

Variable credit course. **4204: CONCEPTS IN COMMUNITY FOOD SYSTEMS** Examination of the economic, political, social, and cultural issues related to community food systems development, food production and biotechnology, food sovereignty and security, and population and environmental health. Analyze models, strategies, and policies of national food systems. Pre: 2204. (3H,3C)

**4214: CAPSTONE: CIVIC AGRICULTURE AND FOOD SYSTEMS**

Multidisciplinary, experiential community-based course focusing on civic agriculture-food systems. Work in partnership with community stakeholders to propose viable solutions to real world issues revolving around civic agriculture and food systems. Connect with communities locally, regionally or globally. Pre: 2204, 3404, 4204. (3H,3C)

**4554 (BIOL 4554): NEUROCHEMICAL REGULATION**

Neurochemical transmission within the vertebrate brain will be examined. Emphasis will be placed on the chemical coding underlying the control of various behaviors and how these systems can be modified by various drugs or diet. Pre: (2304 or BIOL 3404), CHEM 2535. (3H,3C)

**4574 (BIOL 4574): SOCIAL BEHAVIOR OF BIRDS AND MAMMALS**

This course examines origins, influences and implications of social behavior in a variety of avian and mammalian species. Emphasis is placed on understanding group organization and dynamics in inter and intra-species situations. Experimental data from several disciplines (e.g., genetics, physiology, biochemistry) are reviewed to demonstrate their associations with behavioral adaptive mechanisms. Avian and mammalian species living in wild, zoo, agricultural, companion and laboratory settings are discussed. Pre: 3104 or BIOL 2004, BIOL 1106. (3H,3C)

**4614 (NR 4614): WATERSHED ASSESSMENT, MANAGEMENT, AND POLICY**

Multidisciplinary perspectives of assessment, management and policy issues for protecting and improving watershed ecosystems. Topics include: monitoring and modeling approaches for assessment, risk-based watershed assessment geographic information systems for watershed analysis, decision support systems and computerized decision tools for watershed management, policy alternatives for watershed protection, urban watersheds, and current issues in watershed management. Pre: Two 4000 level courses in environmental/natural resource science, management, engineering, and/or policy in BSE, CEE, FOR,

FREC, GEOL, LAR, CSES, ENT, BIOL, GEOG, AAEC, UAP or equivalent. (2H,2C)

4714 (HORT 4714): GLOBAL SEMINAR

Student-centered internet-based course including text and real-time video conferencing among students at collaborating institutions in the United States and Canada. Focus is contemporary North American environmental sustainability issues based on student-prepared case studies. Pre-requisite: Junior or Senior Standing required. (1H,1C)

4964: FIELD STUDY/PRACTICUM

Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## College of Architecture & Urban Studies

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### Overview

### Course Descriptions & Programs of Study

#### School of Visual Arts

- Art and Art History
- Creative Technologies
- Studio Art
- Visual Communication Design

#### Myers-Lawson School of Construction

- Building Construction
- Real Estate

#### School of Architecture + Design

- Architecture
- Industrial Design
- Interior Design
- Landscape Architecture

#### School of Public and International Affairs

- Urban Affairs and Planning
- Environmental Policy and Planning
- Public and Urban Affairs

**Dean:** A. Jack Davis

**Associate Dean for Academic Affairs:** Sonia Hirt

**Associate Dean for Research:** Robert P. Schubert

**Associate Dean for Graduate Studies and Outreach:** Patrick A. Miller

Web: [www.caus.vt.edu](http://www.caus.vt.edu)



## Overview

The College of Architecture and Urban Studies is comprised of four Schools. The School of Architecture+Design includes accredited undergraduate and graduate programs in architecture, landscape architecture, industrial design, and interior design. The School of Public and International Affairs includes undergraduate programs in public and urban affairs and environmental policy and planning; graduate programs in public administration, public and international affairs and urban and regional planning; and doctoral programs in public administration and Governance and Globalization. The Myers-Lawson School of Construction, the first of its kind in the nation, brings together the Department of Building Construction in the College of Architecture and Urban Studies, and the Vecellio Construction Engineering and Management Program in the Via Department of Civil and Environmental Engineering which includes graduate and undergraduate programs in building construction and in construction engineering and management. The college is also the administrative home to the Program in Real Estate, an innovative interdisciplinary undergraduate degree program spanning six colleges, combining theory and industry practice. The School of Visual Arts offers undergraduate programs in art history, studio art, and visual communication design as well as a Master's of Fine Arts in creative technologies and a Master's in Material Culture and Public Humanities, jointly with the College of Liberal Arts and Human Sciences.

These programs share a common purpose—to understand and mold the built environment through acts of creation, design, construction, and analysis. These forces give meaning to the built environments that shape our lives.

Research and outreach programs supplement instructional efforts and are carried out through college centers and laboratories. Specialized research and outreach centers offer students and faculty members opportunities for concentrated investigations in such areas as history and theory of art and architecture, housing, metropolitan studies, community design, construction safety and health, high performance learning environments, community health, governance and accountability, public policy, women in architecture, environmental design and planning, and visual design.

The college offers a range of advanced digital technologies including an array of rapid prototyping devices and a wide range of computing and graphic equipment in support of the instructional and research programs of the college. The Environmental Systems Laboratory and the Research and Demonstration Facility (RDF) are available to faculty members and students for the conduct of research,

in-depth investigations of environmental systems, prototype development, and industrial, graphic, and product design. To support these endeavors, the college has the Virtual Environments Laboratory (VE Lab), Center for Advanced Visual Media, and the Visual Design Studio for Education, Research, Exhibition, and Outreach.

The Art and Architecture Library, a branch of the University Libraries, is located in Cowgill Hall and houses more than 60,000 volumes, 200 periodicals, and 65,000 architectural slides. The college also provides media facilities - VTR systems, photographic, darkroom, print making, ceramics, and cinematographic space and equipment, and wood and metal shops.

The college's Washington-Alexandria Architecture Center and Northern Virginia Center in Old Town Alexandria provide opportunities for architecture, landscape architecture, public administration, and urban and regional planning students to spend one or more semesters in the Washington, DC metropolitan area examining the range of design and planning problems found in large urban centers. In addition to classes, studios, and curricula at the undergraduate and graduate levels, the centers offer research and continuing education opportunities for students, faculty, and alumni, and facilitates participation in the rich educational and cultural opportunities of the greater Washington area.

The Europe Studio, based at the University's Center for European Studies and Architecture in Riva San Vitale, Switzerland, provides undergraduate and graduate study opportunities for students college-wide. Studios, seminars, and organized travel are offered. The college also sponsors an array of additional study abroad opportunities, including study-travel programs elsewhere in the world.

Students who wish to combine degree options within the college or with related disciplines within the university should contact the major school or department regarding special undergraduate and graduate program requirements.

A Summer Qualifying Design Lab in the School of Architecture + Design is required for Virginia Tech students wishing to transfer or change their major into the architecture, landscape architecture, industrial design, or interior design degree program.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## College of Engineering

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- [Electrical and Computer Engineering](#)
- [Engineering Education](#)
- [Engineering Science and Mechanics](#)
- [General Engineering](#)
- [Industrial and Systems Engineering](#)
- [Materials Science and Engineering](#)
- [Mechanical Engineering](#)
- [Mining and Minerals Engineering](#)

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**Dean:** G. Don Taylor (Interim)

**Associate Dean for Academic Affairs:** Bevlee A. Watford

**Associate Dean for Administration and Chief of Staff:** Edward L. Nelson

**Associate Dean for International Programs and Information Technology:** Glenda R.

Scales

**Associate Dean for Research and Graduate Studies:** John J. Lesko

Web: [www.eng.vt.edu](http://www.eng.vt.edu)



## Mission of the College

Virginia Tech is the home of the commonwealth's leading College of Engineering. It is known in Virginia and throughout the nation for the excellence of its programs in engineering education, research and public service. It is the state's largest engineering college, and ranks among the top five suppliers of new B.S. degrees in the United States.

The mission of the College of Engineering is to offer high quality support for our stakeholders in order to provide a successful experience in the engineering education pursuits of our customers. The vision of the college is to foster strong working relationships between faculty, student and industry partners that will ultimately bring research opportunities through engineering educational offerings. The goals of the college are to attract high-caliber students and to provide them with a top-quality engineering education in preparation for productive careers; to invest in faculty development to enhance Virginia Tech's reputation as a research university and a leader in graduate education; and to forge new links with industry and government to facilitate economic development within the Commonwealth and the nation.

The College of Engineering offers bachelor of science degrees in the following areas: Aerospace Engineering, Biological Systems Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Computer Science, Construction Engineering and Management, Electrical Engineering, Engineering Science and Mechanics, Industrial and Systems Engineering, Materials Science and Engineering, Mechanical Engineering, Mining Engineering, and Ocean Engineering. The Computer Science program is accredited by the Computing Accreditation Commission of ABET, [www.abet.org](http://www.abet.org). All other College of Engineering undergraduate programs in engineering are accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

Engineers play an important role in modern society. They design and develop new and better materials, products and processes for households and industries, from tiny semiconductors to huge dams.

Engineers are needed across a broad spectrum of industry from the traditional field such as mechanical to the emerging fields of robotics and biomedicine. Engineers must not only satisfy society's demand for improved performance, reliability and safety of products, they also are expected to supply solutions for environmental and social problems created by new technology.

Our graduates are well-rounded. Men and women trained in engineering will find many professional outlets. They may join large or small manufacturing industries or they may offer their skills and knowledge as professional consultants. They may work in government or private research laboratories or teach and do research in universities. If the future leads them into other professions such as medicine, law, food services or business, their engineering education shall provide a sound base. Graduates of the College of Engineering are in high demand. Our Student Engineers' Council-run Engineering EXPO -- one of the largest student-run career fairs in the country -- brought in approximately 275 employers in 2015, and we are a key recruiting school for three dozen major corporations and government agencies.

It is essential that engineers, regardless of specialty, be well versed in mathematics, the physical sciences and the engineering sciences so that they can adapt readily to meet the profession's ever-changing demands. But professional training is not enough. Engineers need to have imagination and insight. They must understand the history and traditions of the society in which they live. They also must be familiar with the social sciences and humanities.

Engineers also must be able to communicate effectively with higher management and the general public. All departments within the college are implementing programs to ensure that every graduate is able to effectively use a variety of spoken, visual and written communication strategies, which are necessary for success as a student, for employment, and for life as a responsible citizen. Additional emphasis is being placed in freshmen engineering classes to emphasize the importance of communications in engineering analysis and design.

Engineers who are well educated, not just well trained, will be better equipped to develop scientific knowledge into useful technology.

## College Rankings

In U.S. News & World Report's "America's Best Colleges 2016" survey, released in September 2015, the College of Engineering's undergraduate program ranked 15th among all undergraduate engineering programs that also offer the Ph.D., and eighth among public universities. The Department of Biomedical Engineering and Mechanics ranked 4th, the Department of Engineering Science and Mechanics ranked 5th, and the Grado Department of Industrial and Systems Engineering ranked 5th. Other notable department rankings are: the Charles E. Via Jr. Department of Civil and Environmental Engineering ranked ninth in civil engineering and 11th in environmental engineering; the Department of Biological Systems Engineering, 6th, the Bradley Department of Electrical and Computer Engineering, 14th; the Department of Mechanical Engineering, 15th; and the Department of Aerospace and Ocean Engineering, 15th.

## Innovations of the College of Engineering

Goodwin Hall, our Signature Engineering Building, houses scores of sensors that currently make it the most instrumented building in the world for vibrations, opened for classes in fall 2014. The roughly 153,000-gross square-foot facility serves as a leading center of engineering education in Virginia. Inside, a 15,000-pound Rolls-Royce Trent 1000 jet engine hangs 15 feet above the floor of the atrium, installed in the summer of 2012 by a team of engineers. The engine acts as an art centerpiece of the structure, and as a learning tool for our students for years to come. Other highlights: A robotics lab with glass walls that allow visitors and passersby to see students at work, and a 3-D printer open to any student's use, and located in the atrium of the building. The building was named after alum Bill Goodwin and his wife, Alice, in fall 2014. The Goodwins donated \$25 million to the construction of the building, a university record for a personal donation. Goodwin graduated with a bachelor's degree in 1962. More information, photos of the first day of classes inside the new building, and a full time lapse of construction, from

beginning to opening, visit: [www.eng.vt.edu/goodwinhall](http://www.eng.vt.edu/goodwinhall).

The College of Engineering-led Institute for Critical Technology and Applied Science (ICTAS) is now housed in the **Hugh and Ethel Kelly Building** on campus, dedicated in the fall semester of 2013. Ethel Kelly's estate provided \$5 million to help cover the cost of the **most recent of three buildings built for the institute**. That building opened in 2011 and is on Washington Street. What is now **Kelly Hall** opened in 2009 and is on Stanger Street. Another \$1 million from the estate will support the new ICTAS Hugh and Ethel Kelly Lecture Series. Hugh Kelly, who died in 1989, earned his bachelor's and master's degrees of electrical engineering in 1937 and in 1938, worked at AT&T's Bell Laboratories, and played important roles in groundbreaking projects, including the 1962 launch of the Telstar communications satellite, the first private venture in space. Ethel Kelly, who died in 2012, generously supported Virginia Tech's **College of Engineering** as a way of honoring her husband's legacy. Hugh and Ethel Kelly were early members of the Committee of 100. They later joined the Ut Prosim and the Legacy Societies. Hugh was a member of the College of Engineering's Academy of Engineering Excellence.

In the summer of 2013, the State Council of Higher Education for Virginia (SCHEV) approved Virginia Tech's request to award **masters and doctoral degrees in nuclear engineering**.

In the spring of 2013 the Virginia Tech College of Engineering and College of Science jointly dedicated the **inVenTs Laboratory's Studio I** on the second floor of Lee Hall. The inVenTs Residential Community provides an interdisciplinary living-learning space for students from engineering, science, and other disciplines to interact and together explore their ability to envision, create, and transform innovative ideas and "in" in the words of Virginia Tech's tagline "Invent the Future". Approximately 1,270 students have used the facility since its fall 2012 soft opening. The inVenTs community includes students from four university groups, the Curie Learning Community and the Da Vinci Biological and Life Sciences Community, both in the College of Science, and the Galileo and Hypatia learning communities within the College of Engineering. The retention rate for the students enrolled in the inVenTs program is almost 100 percent.

In 2014 at Randolph Hall "in" in space occupied by classes and labs now at Goodwin Hall, the Frith Freshman Design Laboratory (Frith Lab) opened as a space designed to support the retention and development of young engineers through hands-on learning, peer mentoring, and authentic problem-solving. Part collaboration and innovation space, part fabrication and prototyping space, and part learning laboratory, the Frith Lab enables first-year engineering students to learn by dissecting, designing, making, and analyzing engineering products. It features a tensile/compression materials testing machine, 3-D printers, laser engraver, CNC router, and drill press, along with various hand tools, housed in toolboxes available for checkout.

At the Virginia Tech Corporate Research Campus, a building dedicated to propulsion research also opened in spring, 2014. The Virginia Tech Board of Visitors giving authorized the \$3.5 million structure in fall 2012. An Aerobiology Building in support of an agriculture/life science and engineering is planned for Kentland Farm, located off campus and heading roughly due west on Prices Fork Road. The facility will facilitate the research of unmanned aerial vehicles used to combat the spread of crop and animal diseases.

The latest national survey, dated June 2015, released by the American Society for Engineering Education (ASEE) ranked the College of Engineering in the following categories for 2014. It was sixth for the number of tenured/tenure track faculty members, tenth for the number of tenured/tenure track women faculty, 17th for the number of African American faculty, 11th for the number of Asian faculty, and fifth for the number of Hispanic faculty. The data was based on a survey of 358 engineering schools. For total bachelor's degrees awarded by schools, Virginia Tech ranked 5th in the nation; for master's degrees awarded, 36th in the nation; and for doctoral degrees, 11th in the nation. In total enrollment, the College ranked 10th in the nation for undergraduates with 7,410 students (with 352 schools reporting numbers) and 20th in the nation for graduates students at 2,045 (with 261 schools reporting numbers).

Out-of-state students in engineering come primarily from Maryland, New Jersey, Pennsylvania, and New York. In the entering 2014-2015 freshman class, the average SAT score for the general engineering student was 1289, with the average math score at 685 and the average verbal score at 604. The average

high school grade point average was 4.15 on a weighted 4.0 scale. Females comprise 23.4 percent of the entering 2015 class. Members of under-represented populations make up 11.9 percent of the freshmen class.

For fall, 2005, 4,800 prospective students applied for admission to the College of Engineering. By fall 2015, more than 9,000 applied, more than a 50 percent increase. Starting with fall 2010, the target size for the freshman engineering class was raised from 1200 to 1300, an 8 percent increase. In fall of 2015 the target was 1650, and some 1800 were admitted. In 2005 the entering engineering freshman class was 15.6 percent female, 2.1 percent African-American, 1.8 percent Hispanic. By comparison, in 2015 the entering engineering freshman class was 23.4 percent female. The number of entering females is a record, however due to the fact that the overall size of the class is also a record, the percentage of entering females is down just slightly from the 25.4 percent of the 2014 entering class. Members of the underrepresented population make up 11.9 percent (numbers no longer directly correlate because students now identify with more than one segment of the population.)

## Green Engineering

Virginia Tech was one of the first universities to formally consider the connection between engineering practice and environmental stewardship from an interdisciplinary perspective. The Green Engineering Program was created in 1995 and serves all departments within the College of Engineering.

This program combines environmentally conscious attitudes, values and principles with science, technology and engineering practice, and focuses this interdisciplinary approach toward improving local and global environmental quality. Based on engineering fundamentals, green engineering analyzes the design of products, processes, and systems to minimize the life cycle environmental impacts, from the initial extraction of raw materials to the energy consumption and waste production during manufacturing to the ultimate disposal of materials that cannot be reused or recycled.

The Green Engineering Program works with students, faculty and the university administration to provide educational and research opportunities with regard to both the environmental impacts and the environmental solutions that can result from engineering practice.

A university-recognized minor allows students to pursue their interests in Green Engineering in addition to their primary degree(s) in the College of Engineering. To obtain this minor, students are required to take 18 credit hours in the minor area as follows: six (6) credits in the two core courses – Introduction to Green Engineering and Environmental Life Cycle Analysis; six (6) credits in interdisciplinary elective courses; and six (6) credits in disciplinary electives within the students' major. Detailed lists of the courses which meet the minor requirements can be found in the Green Engineering Web site at [www.eng.vt.edu/green](http://www.eng.vt.edu/green).

## Examples of Accomplishments at the National Level

In August 2015, Marc Edwards, professor of civil and environmental engineering and his team of students and research scientists uncovered widespread lead-in-water contamination in Flint, Michigan. The team collected samples from locations across Flint and found extremely high levels of lead and other contaminants in the city's drinking water. In March 2016, the Virginia Tech team of students returned to Flint on spring break, working alongside citizen volunteers in Flint collecting water samples for another round of lead testing. Results from the second round of testing showed Flint water is still not safe to drink, but should be continued to be used, flushing lead from the system, allowing the system to heal. Edwards, a leading expert in safe drinking water and the deterioration of the water delivery infrastructure in America's largest cities, has worked to seek solutions to the crisis. He serves on Michigan Gov. Snyder's advisory group and has testified multiple times before Congress on the crisis. Edwards was named on Time's top 100 list of influential world leaders in April 2016.

The Hyperloop at Virginia Tech team, Vhyper, scored big in Texas with a fourth place finish and a Technical Excellence Award against more than 120 teams representing many of the top universities in the world. The Hyperloop competition pitted teams designing systems for the Hyperloop transportation

system, a project initiated by SpaceX and Tesla founder Elon Musk. The Hyperloop is a high-speed transportation system using a near-vacuum tube to propel a passenger-carrying pod at speeds potentially in excess of 700 miles per hour. The Virginia Tech team's design incorporates magnets not only to levitate the pod, but also to provide braking power. The team will be one of more than 20 that move on to build a prototype to be tested at a 1.5 kilometer test track facility in California, summer 2016.

President Barack Obama announced the creation of the Next Generation Power Electronics Manufacturing Innovation Institute. North Carolina State University is leading this effort with a major engagement from Virginia Tech's Center for Power Electronic Systems (CPES). Over 25 other organizations will participate in this research effort on wide band-gap semiconductor power electronics. The research is funded at \$140 million over five years, with half from the Department of Energy and half from the participating organizations. Members of the electrical and computer engineering department will work on this initiative. More can be found here: <http://energy.gov/articles/factsheet-next-generation-power-electronics-manufacturing-innovation-institute>.

The Department of Engineering Science and Mechanics (ESM) and the Department of Biomedical Engineering (a.k.a. the School of Biomedical Engineering and Science, SBES) merged in 2014, creating the Department of Bioengineering and Applied Mechanics (BEAM). Pamela Vandevord serves as the interim department head of Biomedical Engineering and Mechanics.

In May 2014, Virginia Tech opened the Virginia Tech-India ICTAS Innovation Center. Located in Swarnabhoomi, which is south of Chennai in Tamil Nadu, the new research center will initially focus on energy harvesting, with much of this research conducted through the mechanical engineering department.

Through its University Technology Centers (UTC), Rolls-Royce has built a network for research and graduate education with 24 universities around the world. Until spring of 2014, only one was located in the United States (Purdue). Building upon Virginia Tech's successful partnering on the Commonwealth Center for Aerospace Propulsions Systems (CCAPS) and the Commonwealth Center for Advanced Manufacturing (CCAM), Rolls-Royce awarded UTC standing for Virginia Tech and the University of Virginia in April of 2014.

Virginia Tech was handpicked to participate in a \$30 million national effort sponsored by the National Collegiate Athletic Association and the U.S. Department of Defense to combat concussions among college athletes and active service military personnel. The initiative has been called the most comprehensive study of concussion and head impact exposure ever conducted, with 25,000 male and female NCAA student-athletes participating in the study. Virginia Tech is focusing on football, women's soccer, men's soccer, and women's lacrosse. Data collected from athletes will be used to help curb head injuries among U.S. Armed Forces personnel. The study was launched by the White House. Serving as principal investigator is Stefan Duma, head of the Department of Biomedical Engineering and Mechanics. Also during the past year, Duma and his research team released long-awaited ranking of hockey helmets in their ability to help protect a player's head from. The research "covered throughout North America" follows long-time work on football helmets, which Duma has focused on the youth, high school, college, and professional levels.

Five months after successfully demoing that an adult-sized robot can locate and put out fires aboard a U.S. Navy ship, student members of the combined **Terrestrial Robotics Engineering and Controls Lab (TREC)** and **Extreme Environments, Robotics & Materials Laboratory (ExtReMe)** labs within the College of Engineering are already working on improving the self-built humanoid that has wowed the Navy. The robot is named SAFFiR -- short for Shipboard Autonomous Firefighting Robot was fabricated in the Goodwin Hall lab. It stands 5 foot 10 inches tall and weighs about 140 pounds. In November 2014 aboard the decommissioned, World War II-era USS Shadwell, the robot walked down a hallway, took a hose in his hand, turned and located a burning fire via thermal imaging just a few yards away, and blasted the flames with water. SAFFiR is part of a new program by the U.S. Office of Navy Research to create new, high-tech tools for sailors to fight fires aboard ships where dangers are many fold. ONR already has spent \$4.5 million on the Virginia Tech project and will increase funding as new, improved incarnations of the robot are built. SAFFiR will gain keener intelligence and visual recognition cues, and stronger more versatile legs, along with plating to protect him from heat, soot, and water. "It's not going to replace Navy firefighters, it's going to assist Navy firefighters," said TREC member Viktor Orekhov, who

finished a doctorate in mechanical engineering in December. In 2015, SAFFiR wowed crowds at the worldwide [DARPA Robotics Challenge](#) in Los Angeles, California by walking roughly 200 feet untethered along a loose dirt path onto pavement.

MathWorks announced in July, 2014 that Virginia Tech took third place in the MathWorks Modeling Award as part of the EcoCAR 2 collegiate engineering competition. The award recognizes the team's use of MATLAB and Simulink for Model-Based Design during the three-year project-based learning competition where students were tasked with the real-world challenge of reengineering a 2013 Chevrolet Malibu by improving its fuel efficiency and reducing its emissions while retaining its performance and consumer appeal.

An aerospace and ocean engineering student team won First place in the NASA-sponsored University Aeronautics Engineering Design Challenge competition with its concept of a twin-fuselage unmanned aircraft fueled by liquid hydrogen. The winning concept was dubbed "Gobble Hawk" by the team. The competition is not meant to create aircraft that will be built and flown, but to spur design skills among college engineering students. Team members were Jordan Ambers, Bennett Coffey, Katie Hettmann, Kyle Johnson, Brian Petrosky, Tristan Pietrzak, Matt Schmit, Cory Reed, and Sarah Woodward.

## Major Undergraduate Scholarships

For the 2015-2016 academic year, over two million dollars in scholarship funds were awarded to undergraduate students in the College of Engineering. Forty-nine entering freshmen received Pratt Scholarship awards and 13 returning students continued their Dean's Scholar award for fall semester 2015. In fall 2015 the College offered 9 new, and continued 13 Eleanor Davenport Leadership Scholarships. The largest sponsor of upper-class scholarships continues to be the Gilbert and Lucille Seay Scholarship Fund, which awards students demonstrating both merit and need.

## Additional Facts about the College

The University Honors Program offers a unique challenge to students with extraordinary intellectual and creative abilities. The program is available to all engineering departments and includes the opportunity for enrollment in accelerated courses, enriched sections, and independent study.

A five-year Cooperative Education program for qualified students is available in all of the engineering curricula. After at least two qualifying semesters, students may alternate semesters of study on campus with work periods in industry. Participants are required to have a minimum of a 2.0 overall grade point average, and students must have earned a 2.0 in the semester prior to any work experience. Individual departments may impose higher GPA restrictions, including ones based on in-major GPA.

Approximately 10,061 students are enrolled in undergraduate and graduate engineering departments at Virginia Tech as of fall 2015. In the entering 2015-2016 freshman class, the average SAT score for the general engineering student was 1291 and the average high school grade point average was 4.12 on a weighted scale. The male to female ratio in the college is 3.2:1. Members of under-represented populations make up 30.1 percent of the freshmen class.

Of the 2014-2015 College of Engineering bachelor's degree graduates who were employed full-time, (the most recent year for which statistics are known), 73 percent were employed in a field related to their major. The average annual salary at the bachelor's level was \$65,000.

## Admission

All students admitted to the College of Engineering as freshmen or external transfers are placed in the Department of Engineering Education and are designated as General Engineering majors. Admission to a degree program is competitive, with departmental restrictions established each year by the college. Upon completion of a set of required freshman-level courses, and completion of 12 hours of A-F graded coursework at Virginia Tech, students with acceptable academic records are eligible for transfer into one

of the college's 14 degree programs.

Students wishing to transfer into an engineering program or change majors from another college or degree program within the university must meet current standards set by the college for each engineering program. All major changes are processed by the Engineering Education department.

The college has a guaranteed admission agreement with the Virginia Community College System. VCCS students who complete the transferable Associate Degree in engineering with a minimum 3.2 overall grade-point-average are guaranteed admission to the College of Engineering as a General Engineering major. Not all Virginia Community Colleges offer engineering courses. The Associate Degree in engineering is offered at Blue Ridge, Central Virginia, Danville, Germanna, J. Sargeant Reynolds, John Tyler, Lord Fairfax, Mountain Empire, New River, Northern Virginia, Piedmont Virginia, Southwest Virginia, Thomas Nelson, Tidewater, Virginia Highlands, Virginia Western, Wytheville.

Engineering Technology credits are not accepted for transfer by the College of Engineering.

## Required Academic Progress

Minimum requirements for graduation include the attainment of at least a "C" (2.0 Grade Point Average) *average*, both overall and in-major. Some departments may have additional requirements or specifications concerning the acceptability of C- or lower grades for in-major courses. Students are expected to sustain progress towards completion of their degree requirements, consulting with their academic advisor regularly.

In addition to meeting university requirements, eligibility requirements for enrollment have been established by individual departments.

Entry into a degree-granting department requires that a student successfully complete all first year required courses, and at least 12 GPA hours at Virginia Tech. All degree-granting majors accept applicants on a space-available basis. The change of major requirements, policies, and dates can be located at: [www.enge.vt.edu/undergraduate-changing-majors.html](http://www.enge.vt.edu/undergraduate-changing-majors.html).

## Graduation Requirements

Degree requirements in the college range from 123 to 136 semester hours. Students should see their departmental advisors to determine the exact requirements of their degree. The 2.0 minimum GPA requirement for graduation also applies to all courses attempted in the student's departmental major; substituted non-departmental courses are not included. Where courses have substantial duplication, credit toward graduation will be given for one course only. Up to 2 credits in physical education may be used toward graduation as free elective credit.

The senior academic year must be completed in residence while enrolled in the major department in the College of Engineering.

Engineering curricula have uniform minimum requirements in the humanities and social sciences. The 18-credit minimum includes 6 credits of Freshman English, usually completed during the first year, and 12 credits of humanities and social science electives selected from Areas 2 and 3 (6 credits each) of the Curriculum for Liberal Education.

Although pass/fail courses may be authorized for those who maintain a GPA above 2.0, students should recognize future disadvantages when transferring to other departments or applying for admission to other professional or graduate colleges. Engineering students are expected to take all major department courses on a grade basis. Independent study and undergraduate research courses are available for those who maintain a GPA above 2.0 overall and in their departmental majors; some departments may require a higher GPA.

The College of Engineering will accept advanced ROTC credit as free elective credit towards graduation.



Some departments in engineering may allow the use of selected ROTC courses to meet technical elective requirements. Consult specific departments in the College of Engineering for information.

## **Degree Requirements**

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are outlined in university publications known as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at [www.registrar.vt.edu/graduation/checksheets/index.html](http://www.registrar.vt.edu/graduation/checksheets/index.html) for degree requirements.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## College of Liberal Arts and Human Sciences

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[School of Education](#)

[Science and Technology in Society](#)

[Sociology](#)

**Dean:** Elizabeth Spiller

**Associate Dean for Academic Policies and Procedures:** Debra Stoudt

**Associate Dean for Administration and Finance:** Brian Shabanowitz

**Associate Dean for Graduate Studies and Research:** Thomas Ewing

**Associate Dean for Undergraduate Academic Affairs:** Robert Stephens

**Director of Academic Support:** Karen Watson

**Director of the Undergraduate Research Institute:** Robert Stephens

**Director of Student Recruitment and Career Development:** Monica Kimbrell

Web: [www.liberalarts.vt.edu](http://www.liberalarts.vt.edu)



## Overview

The College of Liberal Arts and Human Sciences offers baccalaureate degrees encompassing the humanities, performing arts, and human and social sciences. The College emphasizes the importance of mastering the intellectual skills a liberal arts education develops as well as job skills by encouraging students to apply knowledge from one field to another and to think creatively.

Outstanding faculty members conduct research and teach courses in 16 departments leading to baccalaureate and advanced degrees. Coursework from the College of Liberal Arts and Human Sciences also provides a foundation of knowledge of a number of fundamental subjects for students in all colleges through the General Education (Curriculum for Liberal Education).

The college offers minors in many of the departments listed. Students are encouraged to include a minor in their program and should consult an advisor for help in choosing one that will advance their career goals.

## General Requirements for Graduation

A student in the College of Liberal Arts and Human Sciences must complete at least 120 hours for an undergraduate degree as well as satisfy the following requirements:

- achieve a minimum overall Grade Point Average (GPA) of 2.0 for all hours attempted (some majors may require a higher GPA)
- achieve a minimum overall GPA of 2.0 for all hours attempted in all work applied to the major (some majors may require a higher GPA)
- complete all other requirements established for their degree by the major department
- complete all college and university Curriculum for Liberal Education requirements
- complete the language study requirement either through high school enrollment or prior to receipt of the undergraduate degree. The minimum requirement may be met in high school by completing 2 units of a single foreign or classical language or American Sign Language. Some majors in the College of Liberal Arts and Human Sciences may require 3 units of a single foreign or classical language or American Sign Language.

No course required for graduation or in the major/minor may be elected to be taken on a pass/fail basis (i.e., pass/fail may be used for free electives only). This excludes courses that are offered pass/fail only.

## General Education - Curriculum for Liberal Education (CLE)

A description of the General Education - Curriculum for Liberal Education (CLE) may be found in the [Academics](#) section of this catalog. For requirements specific to departments in the College of Liberal Arts and Human Sciences, please contact the individual department.

## Honors College

The University Honors Program is available to students in the College of Liberal Arts and Human Sciences. These programs provide an enriched environment for qualified students who are highly motivated and possess outstanding scholastic ability. Specific requirements for the three possible honors degrees are available from the [University Honors Program](#), participating departments and the Office of Undergraduate Academic Affairs.

## Dean's List

A student enrolled in the College of Liberal Arts and Human Sciences for 12 hours or more for grade (A-F) who earns a GPA of 3.4 or higher during the fall or spring semesters can request from the Undergraduate Academic Affairs Office a Dean's List certificate.

## Scholarships

A number of scholarships are available for outstanding students enrolled in the College of Liberal Arts and Human Sciences. Descriptions and deadlines are available on the [college website](#). Students who are interested in applying for financial merit-based aid should contact the [Office of University Scholarships and Financial Aid](#).

## Undergraduate Research

Undergraduate research is a commitment of the college. The Undergraduate Research Institute aims to expose undergraduates to investigation, inquiry, and creative expression in the liberal arts and human and social sciences, enhancing the opportunities for advanced research initiatives, elevating the visibility of that research, and providing access to a variety of resources for student development and faculty

mentorship. Departments within the College of Liberal Arts and Human Sciences have a variety of research opportunities in which students may choose to participate. Students interested in undergraduate research should contact the department where they wish to conduct research.

## Internships, Field Study, Co-op Opportunities, and Study Abroad

Students are encouraged to participate in Internship, field study, and Co-op opportunities to gain relevant work experience prior to graduation. Departmental internship coordinators and career advisors can help students identify opportunities. In some cases students can receive credit for qualifying work experience. Study abroad experiences are highly encouraged for students in the College of Liberal Arts and Human Sciences and students should meet with their academic advisor or contact the Office of Undergraduate Academic Affairs for information.

## Career Advising

Career advising is available from a number of sources. The university offers centralized career services and on-campus interviewing. The College of Liberal Arts and Human Sciences works with employers interested in hiring students with degrees from the college and organizes employer panels and information sessions specifically tailored to majors in the college. Students are encouraged to go to all career fairs that are offered on campus. The college offers a 1-credit course, LAHS 3004, Professional Seminar designed specifically for liberal arts and human sciences majors as they prepare for careers and/or graduate and professional school. Additionally, every major has a departmental career advisor who specializes in guiding students from their field towards career success.

## Pre-Professional Advising

The University provides pre-professional career advisors for all disciplines and the college provides career advisors in areas related to the College.

- Pre-law advisors are based in the College but advise students from any discipline. In addition they advise a pre-law student organization that any Virginia Tech student interested in the law can join. In addition, several majors in the College of Liberal Arts and Human Sciences offer pre-law concentrations which students may take if they are interested in pursuing a graduate program in law.
- A health professions advisor is located in Career Services and provides advising on entering professional programs such as medical, occupational therapy, physical therapy, nursing and dental school to all students
- Pre-Education Advising – The College of Liberal Arts and Human Sciences provides Pre-Education Advising through a coordinator, based in the School of Education, who assists Virginia Tech undergraduate students interested in pursuing a career in PK-12 education. Because teacher licensure in Virginia is generally a graduate program the Coordinator is instrumental in providing resources and information for students to plan their undergraduate courses to best position themselves for successful admission to and completion of a graduate degree in Education (including teacher licensure).

## Graduate Programs

Many of the College of Liberal Arts and Human Sciences departments offer graduate degrees at the Master's and Ph.D. levels. Complete information on these programs including descriptions of graduate courses can be found in the [Graduate Catalog](#).

## Undergraduate Course Descriptions (LAHS)

### 1004: FIRST YEAR EXPERIENCE: INTRODUCTION TO A RESEARCH UNIVERSITY

Introduces first-year Liberal Arts and Human Sciences majors to the university's research mission and the scope and nature of research within the disciplines in the college. Prepares students to participate in the university's research mission through undergraduate research. Focuses on building problem-solving, inquiry, and integration skills as foundational to academic success. Topics include an introduction to academic support resources, academic planning, career exploration, and e-portfolio.  
(3H,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2974H: INDEPENDENT STUDY

Honors Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3004: PROFESSIONAL SEMINAR

Designed specifically for liberal arts and human sciences majors, this course prepares students for careers and/or graduate school. Interviewing, resume writing, the graduate school application process, writing personal statements, electronic job searching, and diversity issues in the workplace are examples of topics covered. Pre: Junior or Senior standing. Major within the College of Liberal Arts and Human Sciences, Junior standing preferred.  
(1H,1C)

### 3954: STUDY ABROAD

Variable credit course.

### 3984: SPECIAL STUDY

Variable credit course.

### 4964: FIELD STUDY

Variable credit course.

### 4974: INDEPENDENT STUDY

Variable credit course.

### 4974H: INDEPENDENT STUDY

Honors Variable credit course.

### 4984: SPECIAL STUDY

Variable credit course.

### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

### 4994H: UNDERGRADUATE RESEARCH

Honors Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## College of Natural Resources and Environment

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- 

**Dean:** Paul M. Winistorfer

**Associate Dean for Administration:** Kay P. Hunnings

**Associate Dean for Engagement:** Robert L. Smith

**Assistant Dean for Administration and Finance:** Thomas E. Olson

**Director of Academic Advising:** Stephanie Lang

Web: [www.cnre.vt.edu](http://www.cnre.vt.edu)



## Overview

The College of Natural Resources and Environment, through offerings in the Departments of Fish and Wildlife Conservation, Forest Resources and Environmental Conservation, Geography, and Sustainable Biomaterials, provides an integrated education in renewable natural resource management, conservation, and utilization as well as a valuable perspective for understanding and solving critical contemporary environmental problems at local, regional, and global scales.

All undergraduate programs of the College of Natural Resources and Environment are designed to provide a professional education that starts with core courses emphasizing physical, biological, and social sciences, along with concepts of renewable natural resource management. More advanced courses teach the principles and practices of individual disciplines, along with advanced skills in communications and computer use. Students prepare for professional careers with public agencies responsible for managing forest, water, wildlife, fish, and recreation resources; with private firms concerned with producing, manufacturing, and marketing wood products; with planning agencies and private firms utilizing skills in environmental and land-use analysis and geospatial techniques; or for graduate studies.

Students develop a specialization. These majors with options are described below and are administered by departments:

### **Department of Fish and Wildlife Conservation**

- Fish Conservation
- Wildlife Conservation

### **Department of Forest Resources and Environmental Conservation**

- Environmental Informatics
- Environmental Resources Management
  - Environmental Resource Management option
  - Watershed Management option
- Forestry
  - Forest Resource Management option
  - Forest Operations and Business option



- Urban Forestry option
- Natural Resources Conservation
  - Conservation and Recreation Management option
  - Environmental Education (K-6) option
  - Natural Resources Science Education (6-12) option
- Water Resources, Policy and Management

### **Department of Geography**

- Geography
- Meteorology

### **Department of Sustainable Biomaterials**

- Packaging Systems and Design
- Sustainable Biomaterials

The college offers minors in Forestry, Urban Forestry, Natural Resource Recreation, Watershed Management, Geographic Information Science, Geography, Meteorology, Sustainable Natural Environments, Wood Science, and Packaging Science. Contact the respective departments for more information on minors.

## **Accreditation**

The educational programs in Forest Resource Management, Forest Operations and Business, and Urban Forestry qualify graduates as professional foresters and are accredited by the Society of American Foresters, the recognized accrediting body. Graduates in fish and wildlife conservation meet certification requirements of the American Fisheries Society and The Wildlife Society, respectively. The Sustainable Biomaterials major is accredited by the Society of Wood Science and Technology, the recognized accrediting body.

## **Honors College**

The University Honors Program is available to students in the College of Natural Resources and Environment. The program provides enriched opportunities for highly qualified and motivated undergraduate students. Faculty advisors can provide additional information.

## **Cooperative Education**

The college encourages students to become involved in the Cooperative Education Program, in which students alternate on-campus academic terms with off-campus employment in their areas of interest. Additional information is provided in "[Academics](#)".

## **Exchange Programs**

The College of Natural Resources and Environment participates in reciprocal exchange program with the University of Canterbury in Christchurch, New Zealand. Where appropriate, students can also participate in the International Student Exchange Program.

## **Graduate Programs**

The college offers educational programs leading to the M.S., M.F., MNR, and Ph.D. Complete information on these programs is in the Graduate Catalog.

## Undergraduate Course Descriptions (NR)

### 1114: INTRODUCTION TO RENEWABLE NATURAL RESOURCES

Introduction to careers in forestry, wildlife, fisheries, recreation, and forest products professional fields. Discussion of current global and regional problems affecting natural resource professionals.  
(1H,3L,2C)

### 1115-1116 (GEOG 1115-1116): SEEKING SUSTAINABILITY

Definition of, conditions of, and strategies for achieving sustainability. 1115: History, current conditions, and trends of sustainability from ecological, economic, and social perspectives. 1116: Detailed conditions and trends, tools for constructing sustainability, integrative project application.  
(3H,3C)

### 1234: FIRST YEAR EXPERIENCE IN NATURAL RESOURCES & ENVIRONMENT

Introduction to problem solving related to natural resources and environmental issues. Developing a sense of identity and place within the college while acquiring skills and knowledge that enhance academic success. Exposure to programs on campus that support sustainability and student success. Introduction to a variety of career pathways within natural resources and environmental conservation.  
(2H,2L,3C)

### 2004 (GEOG 2004): INTRODUCTION TO WATER RESOURCES AND ENVIRONMENTAL ISSUES

Introduction to the hydrologic cycle, water resources, and related environmental issues. Emphasis on relationships between human needs for and effects upon water including; factors influencing water quality, droughts, and floods; water for health, energy, and food; water laws, allocation, and conflict; water resources and climate change; and potential solutions for these and other critical water issues. Pre: Sophomore-level standing.  
(3H,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3954: STUDY ABROAD

Variable credit course.

### 3964: FIELD STUDY

Variable credit course.

### 4014 (FOR 4014): NATURAL RESOURCES ECONOMICS

Examination of domestic and international natural resource use, exploitation, and degradation problems, with special focus on use of economics to understand why potential overuse of natural resources exists, and what policy options are available to correct these problems and ensure sustainable natural resource use over time. Water, forests, fisheries, land and exhaustible resources. Permission of instructor may be substituted for the pre-requisite. Pre: ECON 2005 or AAEC 1005.  
(3H,3C)

### 4105-4106: LEADERSHIP IN NATURAL RESOURCES

Preparation for leadership roles in the natural resource professions. Introduction to theories of leadership; characteristics of effective leaders; leading and working in interdisciplinary teams. Techniques of meeting facilitation; written and oral communication skills in a leadership context. Effects of preferred modes of interacting with others, perceiving information, making decisions, and approaching tasks on the ability to lead and work with others. Consent of instructor. Pre: FIW 2114 or FOR 2314 or GEOG 3104 or SBIO 2124 for 4105; 4105 for 4106.  
(3H,3C)

### 4444: PRACTICING SUSTAINABILITY

Practicum in sustainability. Synthesize and integrate knowledge from undergraduate career and apply to real world problems of sustainability. Topics and projects selected from opportunities to examine specific local and regional sustainability issues on the VT campus, in the New River Valley and the Commonwealth at large. Pre-requisite: Senior Standing required.  
(3H,3C)

**4614 (ALS 4614): WATERSHED ASSESSMENT, MANAGEMENT, AND POLICY**

Multidisciplinary perspectives of assessment, management, and policy issues for protecting and improving watershed ecosystems. Topics include: monitoring and modeling approaches for assessment, risk-based watershed assessment, geographic information systems for watershed analysis, decision support systems and computerized decision tools for watershed management, policy alternatives for watershed protection, urban watersheds, and current issues in watershed management. Pre: Two 4000 level courses in environmental/natural resource science, management, engineering, and/or policy in BSE, CEE, FOR, GEOL, LAR, CSES, ENT, BIO, GEOG, AAEC, UAP or equivalent.  
(2H,2C)

**4964: FIELD STUDY**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Pamplin College of Business

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**Dean:** Robert T. Sumichrast

**Associate Dean for Administration:** Kay P. Hunnings

**Associate Dean for Extended Campus:** Parviz Ghandforoush

**Associate Dean for Research and Faculty Affairs:** Kent Nakamoto

**Assistant Dean for Undergraduate Programs:** Candice E. Clemenz

Web: [www.pamplin.vt.edu](http://www.pamplin.vt.edu)



## Overview

### Range of Programs

The Pamplin College of Business offers majors in Accounting and Information Systems, Business Information Technology, Economics, Finance, Hospitality and Tourism Management, Management, and Marketing. Its on-campus enrollment is over 3,700 undergraduates and about 200 full-time graduate students in the MBA-Business Analytics, Master of Accounting and Information Systems, Master of Hospitality and Tourism Management, Master of Marketing and Ph.D. programs. The college also enrolls over 150 evening MBA and about 50 executive MBA students at Virginia Tech's National Capital Region campus in metropolitan Washington, D.C., and about 60 professional MBA students, who take classes that alternate between Roanoke and Richmond. The college also enrolls over 350 students in our online Master of Information Technology.

### Competitive Advantages of Pamplin

The college offers five distinct competitive advantages:

1. start in the business school from day 1
2. graduate with a strong business foundation
3. get jobs (90% with a job in their field at graduation)
4. develop skills through hands-on experiences
5. connect with engaged alumni

### Groundbreaking Research, Eminent Scholarship

Pamplin faculty members are tackling major issues in industry, finance, management practice, and information technology, to name a few areas. Their research has contributed to greater understanding of business issues, been cited in government hearings and court testimony, and played a role in policy making. Though sponsored research is not a central aspect of the research programs of business schools, several Pamplin faculty members have attracted national funding for their research, working as members of interdisciplinary teams. The college's departments are also regularly ranked among the nation's or world's top programs for scholarly productivity, based on article publication in the leading academic journals in their fields.

## Centers

The college offers two centers devoted to helping students and corporations gain more knowledge. The Apex Systems Center for Innovation and Entrepreneurship helps students to learn, lead, and launch. Students will learn to be empowered with skills, tools, and information to create successful ventures. They will launch ventures through support and resources that will help them transform vision to reality. Finally, the center will lead the next generation of entrepreneurs and help them to have courage to build exceptional ventures. The Center For Business Intelligence and Analytics will assist with big data and harnessing analytic techniques to transform raw data into useful information for better business decisions.

## Curriculum

The curriculum includes a broad liberal education and business core foundation of two years, followed by a college core in the fundamentals of business theory and concentration in the major. The college offers majors in:

- Accounting and Information Systems
- Business Information Technology
- Economics
- Finance
- Hospitality and Tourism Management
- Management
- Marketing

Academic advising is an important aspect of each student's college career. We pair students with a professional academic advisor to assist from entry in Pamplin until graduation. All students are advised in Pamplin Undergraduate Programs, 1046 Pamplin Hall.

Undergraduates are strongly encouraged to participate in the out-of-class activities of the college, particularly the annual career fairs in September and January; the placement seminars; the ethics and leadership seminars; college international programs and study abroad; and the various events of the over 30 different student clubs in the college. Many of these programs provide critical insights into the careers for which students are preparing, as well as valuable opportunities for leadership.

Undergraduates are required to bring a computer to the university, as well as purchase a university and a Pamplin software bundle. The computer is used extensively in the curriculum. Purchase information and required configuration will be available each spring.

## Facilities

Administrative and faculty offices for the college are located in Pamplin and Wallace Halls. Our facilities also include study rooms, computer labs, conference rooms, a behavioral laboratory, a kitchen laboratory, an atrium filled with furniture conducive to studying and group work, and a student organization office center.

## Accreditation

The college is a member of The Association to Advance Collegiate Schools of Business, AACSB International. All programs are accredited by the AACSB. In addition, the ACIS program has an additional accreditation from AACSB: AACSB Accounting Accreditation. Additionally, the Finance department is accredited through the Certified Financial Planning Board of Standards, Inc.

## General Requirements for Graduation

A minimum of 125 semester hours is required for graduation in each curriculum.

The student must have an overall average GPA of 2.0 ("C") on all work attempted and in the courses in the major.

To ensure credit, a student desiring to take courses at another institution must secure approval by Undergraduate Programs of the Pamplin College before registering for the course at another institution. Completion of the "Authorization to Take Courses Elsewhere" must be turned into 1046 PAM and the student will be notified by email of the outcome of the review.

Acceptance of work completed at junior or community colleges is limited to those courses offered at the freshman-sophomore level at Virginia Tech. General university limitations on acceptability of transfer credit are shown elsewhere in this catalog.

## **Degree Requirements**

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at [www.registrar.vt.edu/graduation/checksheets/index.html](http://www.registrar.vt.edu/graduation/checksheets/index.html) for degree requirements.

## **Program for First Two Years**

All students in business generally take the same required courses for the first two years. A major within the college may be selected during the first two years, but must be selected no later than the end of the semester in which the student attempts 72 semester hours. Because Economics is an unrestricted major within the College of Business, students in ECON who did not enter the university as BUS or ECON, must apply if they wish to change into ACIS, BIT, FIN, HTM, MGT, and MKTG. HTM is a restricted major. Students who did not enter the university as BUS or HTM must apply if they wish to change or add into another business major. The college accepts applications from students outside of Pamplin, but at VT, three times a year - May, August, and January. Students must have a GPA of 2.0 or better in the combined series in accounting and information systems, business information technology, economics, and mathematics with no grade less than C- in the nine designated courses in these departments and have an overall GPA of 2.0 or better for all course work. Pamplin enforces a strict policy of progress toward degree (Policy 91). The above requirements must be met by 72 credits (90 credits for transfer students) or the student will be dismissed from the college (not Virginia Tech) and not allowed to enroll in any business major. Some junior level courses may be taken at 45 credits, if the student has taken the required pre-requisite courses.

## **Business Core**

All business students take the same business core, regardless of major. The core creates a strong foundation in all aspects of business. All core course require a C- or better or must be repeated. Students at the university may only attempt a course three times. The core courses are: ACIS 1504,2115, 2116; BIT 2405, 2406; ECON 2005, 2006; FIN 3054 or 3074, and 3104; MATH 1525,1526; MGT 3304, 4394; and MKTG 3104.

## **Applied Business Computing Minor**

The 18-19 credit Applied Business Computing minor is open to students in all majors across the campus. This minor will help students gain better understanding of the web and systems design. It includes courses in Accounting and Information Systems, Business Information Technology, Computer Science, and Engineering. To apply students may obtain an application from the ACIS department. For more

information, please contact the ACIS department at 540-231-6591.

## Business Minor

Students with majors outside Pamplin may apply for a minor in business if they have competitive grades in required courses, a minimum 2.0 overall GPA on at least 24 semester hours at Virginia Tech, if they have completed Math 1525-1526 or its equivalent, and if they have at least a C- in any ACIS, BIT, ECON, FIN, MGT, or MKTG, course which they have taken. The minor consists of 27 semester hours of lower division course work which must be successfully completed before taking the 15 semester hours of upper division courses. In order to complete the minor in business, students must have a 2.0 GPA in the 15 semester hours of upper division courses. Applications are available in 1046 Pamplin.

The requirements to earn a minor in business can be found on its checksheet by visiting the University Registrar website at [www.registrar.vt.edu/graduation/checksheets/index.html](http://www.registrar.vt.edu/graduation/checksheets/index.html).

## Center for Leadership Studies and Leadership Minors

The Center for Leadership Studies coordinates leadership programs across campus including the Corps of Cadets Center for Leader Development, the Department of Management's Business Leadership Center, and other leadership activities organized by the Pamplin College of Business, Student Affairs, and Interdisciplinary Studies. Currently, the college administers two minors: the Virginia Tech Corps of Cadets minor in leadership studies and the Department of Management Business Leadership minor.

For more information on the 18-credit Corps of Cadets minor in leadership, see the material in the ROTC section of the catalog or contact the Center for Leader Development, (540) 231-7136.

The 18-credit Business Leadership minor is open to students in all majors who have at least a 2.50 overall GPA at Virginia Tech. It includes required courses in management theory and leadership practice, ethical leadership and corporate social responsibility, and advanced skills in leadership; elective courses from business, communication, humanities, and sociology; and a required leadership experiential activity. For additional information, contact Ms. Lorraine Borny, Business Leadership Center, (540) 231-2604.

## Entrepreneurship-New Venture Growth Minor

The Entrepreneurship-New Venture Growth Minor is intended to focus on the knowledge and skills to create new ventures and lead their early growth. The objective is to provide students with the knowledge and skills needed to convert ideas into business successes, particularly in the context of engineering and science-based technology commercialization.

The curriculum consists of eighteen (18) credit hours of study, including six (6) hours of business restricted electives, and six (6) hours of restricted electives.

## International Business Minor

Sophomores, juniors, and seniors in the Pamplin College who have at least a 2.0 overall GPA are eligible for the International Business minor of 18 semester hours of course work; 3 years of a foreign language (may be satisfied from high school), and an approved international experience.

The requirements to earn a minor in international business can be found on its checksheet by visiting the University Registrar website at [www.registrar.vt.edu/graduation/checksheets/index.html](http://www.registrar.vt.edu/graduation/checksheets/index.html). Applications for this minor are available in 1046 Pamplin Hall.

## Professional Sales Minor

Sales positions are critical to all firms and sales positions are expected to increase by as much as 25%



over the next several years. This has created strong competition among employers to recruit the very best graduates. The Professional Selling minor is designed to prepare students to excel in this highly lucrative field. The focus of the program is to provide students with critical communication, interpersonal, and presentation skills key to helping organizations build long-term customer relationships. These skills will be valuable not only to those pursuing sales careers but also to anyone aspiring to managerial positions - positions that involve presentation of plans and ideas, negotiations, and persuasion. This minor requires 6 specified courses to be completed with at least a 2.0 GPA overall and within the courses.

## Cooperative Education Programs in Business

The college participates in the Cooperative Education Program in which qualified students may alternate semesters of study in the major with semesters of professional employment. Additional information pertaining to the program is included in the "[Academics](#)" section of this catalog.

## Graduate Programs in Business

Graduate instruction and opportunities for research are offered to students who have bachelor's degrees from accredited colleges. The college offers the Master's of Business Administration programs, and master's and Ph.D. degrees in all departments. All graduate students are required to attain a satisfactory score on the Graduate Management Admission Test (GMAT).

## Preparation for Law

The four-year course leading to the B.S. degree in any major in the college provides a sound preparation for law school, and pre-law advisors from the Pamplin faculty are provided.

## Economics

Economics is offered as a major through both the Pamplin College of Business and the College of Science. Both an honors degree and a minor in economics are also offered in the College of Science. Students in either college take the same economics courses, but the college core requirements differ.

For economics faculty and course descriptions, visit Economics in the [College of Science](#).

## Undergraduate Course Descriptions (BUS)

1984: SPECIAL STUDY

Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

3974: INDEPENDENT STUDY

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## College of Science

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**Dean:** Sally C. Morton

**Associate Dean for Curriculum and Instruction:** Gary L. Long

**Associate Dean for Research and Graduate Studies:** Randy Heflin

**Associate Dean for Strategic Initiatives:** JP Morgan

**Assistant Dean for Undergraduate Studies:** Jerry W. Via

**Assistant Dean for Finance and Administration:** Janet Sanders

**Director of the Academy of Integrated Science:** Michel Pleimling

Web: [www.science.vt.edu](http://www.science.vt.edu)



## Overview

The College of Science at Virginia Tech provides students with an interdisciplinary training in analytical skills and a comprehensive foundation in the scientific method. Outstanding faculty members conduct research and teach courses in fourteen disciplines leading to baccalaureate and advanced degrees. Coursework from the College of Science also provides a foundation of knowledge in a number of fundamental and advanced subjects for students in all Colleges across the campus. The College of Science also offers academic advising and appropriate preparatory coursework for students interested in pre-medicine, pre-dentistry, pre-veterinary medicine, and patent or intellectual property law.

## Degree Programs

Specific degree programs include:

- Biochemistry (B.S.)
- Biological Sciences (B.S.)
- Chemistry (B.S. or B.A.)
- Computational Modeling and Data Analytics (B.S.; option in Physics, track in Economics)
- Economics (B.A.)
- Geosciences (B.S.; options in Geology, Geochemistry, Geophysics, Earth Science Education)
- Mathematics (B.S.; options in Traditional Mathematics, Applied Computational Mathematics, Applied Discrete Mathematics, and Mathematics Education)
- Microbiology (B.S.)
- Nanoscience (B.S.)
- Neuroscience (B.S.; .; Clinical Neuroscience, Computational and Systems Neuroscience, Cognitive and Behavioral Neuroscience, Experimental Neuroscience)
- Physics (B.S. or B.A.; options in Physics Education, Pre-Law, Pre-Health)
- Psychology (B.S.)
- Statistics (B.S.)
- Systems Biology (B.S.)

In addition to traditional majors, the college offers courses in intellectual property law, and supports research centers in areas such as biomedical and public health sciences, applied mathematics, macromolecular science, and many other critical technologies and applied sciences that encompass other Colleges at the University. Allied disciplines emphasize the study of behavioral science as well as economic and strategic decision making. The College is committed to providing research opportunities for interested students at all levels.

The college offers minors in:

- Actuarial Science
- Astronomy
- Biological Physics
- Biological Sciences
- Chemistry
- Economics
- Geosciences
- Mathematics
- Nanoscience
- Physics
- Psychology
- Science, Engineering, and Law
- Statistics

A Leadership minor is available to members of the Corps of Cadets.

## General Requirements for Graduation

A student in the College of Science must complete at least 120 hours for an undergraduate degree as well as satisfying the following requirements:

- achieve a minimum overall Grade Point Average (GPA) of 2.0 for all hours attempted
- achieve a minimum overall GPA of 2.0 for all hours attempted in all work applied to the major
- complete all other requirements established for their degree by the major department

- complete all college and Curriculum for Liberal Education requirements

No course required for the major/minor may be elected to be taken on a pass/fail (P/F) basis (i.e., pass/fail may be used for free electives only). This excludes courses that are offered P/F only.

## College Core Curriculum

A description of the General Education (Curriculum for Liberal Education) may be found in the Academics chapter of this catalog or on the Curriculum for Liberal Education website ([www.cle.prov.vt.edu](http://www.cle.prov.vt.edu)). College Specific Requirements related to the Curriculum for Liberal Education (CLE):

### Area 6: Creativity and Aesthetic Experience

- Satisfactorily complete a three-credit hour course approved for the university Curriculum for Liberal Education. (The one-credit courses for the CLE will not fulfill this requirement.)

Foreign Language— Must complete the third year (level III) of a single foreign language [including Sign Language (ESL)] in a secondary school. This requirement may also be fulfilled by successful completion of one of the following:

- Satisfactorily complete 1106 for any foreign language offered including any prerequisites
- Satisfactorily complete an accelerated course which combines 1105 and 1106 of a foreign language
- Students who have not completed two (2) units of a single foreign language in high school must satisfactorily complete 1106 or an accelerated course which combines 1105 and 1106 of a foreign language. These hours are in addition to the 120 hours required for graduation, so these hours will not count towards graduation.
- Credit by examination for a foreign or classical language. The credit by examination option is available only to students who have gained knowledge of a foreign language without the benefit of formal training. This privilege is intended to recognize informal, non-academic learning experience. This option is restricted and does not carry credit towards graduation. Requests must be made through the Foreign Language office. See <http://www.collegeboard.com/student/testing/clep/about.html> for available tests and procedures.
- Students whose native language is not English may be exempted from the foreign language requirement through demonstrating satisfactory knowledge of the foreign language as prescribed by the Department of Foreign Languages and Literatures. All requests for exemption should be addressed to and must be approved by the head of the Department of Foreign Languages and Literatures. This option does not carry credit towards graduation.

## Satisfactory Progress

In addition to the university and to the departmental criteria (see specific departments in this chapter), all students in the College of Science are evaluated for continued enrollment at Virginia Tech. The two College of Science criteria for satisfying progress toward degree state that:

1. Students who have attempted 72 semester hours must have completed their foreign language requirement by the close of the academic year (Spring Semester), and
2. Students must have completed all credits for the Curriculum of Liberal Education by the time 96 semester hours have been attempted.

## Honors College

The University Honors Program is available to students in the College of Science. These programs provide an enriched environment for qualified students who are highly motivated and possess outstanding scholastic ability. Specific requirements for the three possible honors degrees are available from the

honors program and participating departments.

## Integrated Science Curriculum

Designed for students seeking an in-depth understanding of 21st century science, the Integrated Science Curriculum (ISC) provides a novel, integrated scientific foundation for any degree program in the College of Science. It employs a collaborative, active-learning environment emphasizing teamwork, skill acquisition, independent thought, and creativity. Structurally, ISC is a 30 credit two-year course sequence that covers the fundamentals of college-level chemistry, physics, and biology integrated with each other and with calculus, linear algebra and statistics. Teamwork, written and oral presentation, and problem-solving are central components throughout the curriculum.

## College Level Minors

Minor in Actuarial Science

[www.stat.vt.edu/undergraduate/actuarial-science.html](http://www.stat.vt.edu/undergraduate/actuarial-science.html)

Actuaries combine knowledge from statistics, finance, and business to assess risk and help create policies that minimize financial risk for individuals and companies. The actuarial profession is consistently ranked near the top of most desirable professions. Please visit the University Registrar website at [www.registrar.vt.edu/graduation/checksheets/index.html](http://www.registrar.vt.edu/graduation/checksheets/index.html) to view the minor checklist detailing requirements.

Minor in Science, Engineering, and the Law

[www.science.vt.edu/ais/stl](http://www.science.vt.edu/ais/stl)

The rights of inventors and authors to royalties for patents and copyrights are protected by intellectual property (IP) law. Today, intellectual property has become a major part of the world's economy and one of the fastest growing areas of law: stem cell research, gene patents, clean technology, file sharing, digital libraries - every day we are faced with a new issue at the intersection of science, technology, and the law. The minor in Science, Engineering, and the Law trains students in the fundamentals of IP law. It identifies and discusses myriad issues that all students who work in the realm of discovery, and who may develop patentable products, need to have knowledge of. This minor is housed in the Division of Science, Technology, and Law within the Academy of Integrated Science.

## Dean's List

An undergraduate student who attempts at least 12 credit hours graded on the A-F option and who earns a 3.4 GPA for either spring or fall semester will be included on the online Dean's List for that term. Please note: Students will not appear on the online Dean's List if they are listed in the system as confidential or if they do not have an active permanent address. Questions about omissions from the online list should be directed to the Office of the University Registrar.

## Pre-Professional Advising in the College of Science

Health professions advising offers services and programs for students at all levels at Virginia Tech. Students interested in any health profession requiring graduate or professional school are encouraged to participate in health professions advising [www.career.vt.edu/HealthProfessionsAdvising/Index.html](http://www.career.vt.edu/HealthProfessionsAdvising/Index.html). Health professions advising is particularly helpful in advising students interested in nursing, dentistry, optometry, veterinary medicine, allopathic medicine (MD), osteopathic medicine (OD), physical therapy, becoming a physician's assistant/nurse practitioner, etc. Advising for students interested in patent or intellectual property law careers is available in the college advising center.

## Phi Beta Kappa

Phi Beta Kappa is the oldest and most prestigious honor society dedicated to recognizing excellence in the liberal arts and sciences. Students in the College of Science who have exhibited outstanding academic ability in eligible coursework may be eligible for selection to Phi Beta Kappa.

## Scholarships

A number of scholarships are available for outstanding students enrolled in the College of Science. Descriptions and deadlines are available on the Scholarships and Financial Aid website.

## Undergraduate Research

Research opportunities and experiencing the excitement of discovery can play an important part in undergraduate training in science. College of Science departments offer diverse research opportunities in which students may choose to participate. Individuals interested in undergraduate research should contact a faculty member in the department where they wish to conduct research.

## Internships, Co-op Opportunities, and Enrichment Programs

Students are encouraged to participate in internship and co-op opportunities to gain relevant work experience prior to graduation. Career advisors in the college advising center as well as departmental career advisors can help students identify opportunities. In some cases, students can receive credit for qualifying work experience. Enrichment studies include field station opportunities, study abroad and summer laboratory experiences outside of the university.

## Career Advising

Career advising is available from a number of sources. The university offers centralized career services and on-campus interviewing [www.career.vt.edu](http://www.career.vt.edu). The College of Science works with employers interested in hiring students with degrees from the college and organizes employer panels and information sessions. Every major has a departmental career advisor who specializes in guiding students from their field towards career success.

Career Services offers each student a FREE Hokies4Hire account. Undergraduate students who are seeking any type of career-related employment, including internships, co-ops, career-related summer employment, and permanent positions are eligible to use Hokies4Hire. You may upload your resume and apply for jobs listed in Hokies4Hire. These include jobs with on-campus interviews as well as job postings. Additional information may be found at [www.career.vt.edu/H4H-OCI/H4HIndex.html](http://www.career.vt.edu/H4H-OCI/H4HIndex.html).

## Graduate Programs in Science

College of Science departments offer graduate degrees at both the Master's and Ph.D. levels. Complete information on these programs including descriptions of graduate courses can be found in the [Graduate Catalog](#).

## Undergraduate Course Descriptions (COS)

1015-1016: SUCCESSFUL STARTS IN SCIENCE: CURIE & DA VINCI LIVING LEARNING COMMUNITIES

First year experience course for students living in the Curie or Da Vinci Living Learning Communities at Virginia Tech. Provides resources and fundamental skills to enhance learning experiences and support academic success in the sciences. Engages students with professional and academic development activities both in the classroom and within a science-themed residence hall. Uses a "learn by doing"

approach to blending technical know-how with leadership, ethical, interpersonal and professional skills fundamental to the practice of science. Requires teamwork to envision, design, and implement research projects while using innovative discipline-specific technology. Provides first-year students with support through a weekly peer mentoring program. 1015: Emphasis on scientific inquiry, curriculum planning, career planning in the sciences, skills to promote academic success, awareness of academic and career resources and opportunities. 1016: Emphasis on collaborative problem-solving skills using innovative discipline-specific technology, critical thinking; Integration of ideas and experiences to encourage life-long learning through service work related to their academic/ career interests.  
(1H,1C)

#### 2164 (ENGR 2164): INTRODUCTION TO SCIENCEERING

Seminar-based course providing a survey of current interdisciplinary science and engineering research problems; introduction to interdisciplinary thinking and communication; issues related to interdisciplinary research teams.

(1H,1C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 4064 (ENGR 4064): SCIENCEERING CAPSTONE

A capstone experience centered around an open-ended, faculty-advised senior project involving the design of a process, material, or technique for solving an interdisciplinary problem. Pre: Enrollment in Interdisciplinary Engineering and Science Minor. Pre: ENGR 2464 or BIOL 2124.

(3H,3C)

#### 4304: PATENT LAW

The protection and enforcement of patent law, U.S. case law that interpret Sections 35 of the US Statutory code; Analysis of the goals and costs of the patent law system; patentability requirements, infringement, remedies, patent prosecution issues, and patent transactions; Patent and intellectual property strategies. Pre: 2304.

(2H,2C)

4324: GLOBAL ASPECTS OF INTELLECTUAL PROPERTY LAW Comparative study of international intellectual property systems; international treaty arrangements for copyrights, patents and trademarks; protection and enforcement of intellectual property rights in foreign markets; policy analysis of the globalized intellectual property system.

(3H,3C)

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (ISC)

#### 1004: INTEGRATED SCIENCE CURRICULUM ORIENTATION SEMINAR

Introduction to the different fields of science and mathematics, and academic and career planning for College of Science majors that are enrolled in the Integrated Science Curriculum. Discussion of academic plans and university and college requirements. Resume building for internships, research experiences, and graduate school. Exposure to areas of practice and research, and opportunities for education, training, and employment in fields of interest to students graduating from the College of Science.



(1H,1C)

#### 1105-1106: INTEGRATED SCIENCE I

Introduction to the fundamental principles of biology, chemistry, physics and mathematics in an integrated environment. 1105: Discrete dynamical systems, differentiation and integration, differential equations, population dynamics, chemical reactions, chemical kinetics, Newton's laws, linear and rotary motion, kinetic and potential energy. 1106: Genetics, evolution, molecular biology, organic chemistry, biochemistry, thermodynamics, statistics, multivariable calculus. Restricted to majors in the College of Science. Only by permission of the instructor. Pre: 1105 for 1106. Co: 1115 for 1105; 1116 for 1106. (6H,6C)

#### 1115-1116: INTEGRATED SCIENCE LABORATORY I

Laboratory component of Integrated Science Curriculum where students conduct project-based interdisciplinary laboratories organized into content modules. 1115: Tools of scientific research, gene delivery, kinetics, solar energy. 1116: Tools of scientific research, water, thermodynamics, plant genetics, surfactants. Restricted to majors in the College of Science. Only by permission of the instructor. Pre: 1115 for 1116. Co: 1105 for 1115; 1106 for 1116. (6L,2C)

#### 2105-2106: INTEGRATED SCIENCE II

Introduction to the fundamental principles of biology, chemistry, physics and mathematics in an integrated environment. 2105 Molecular cell biology, metabolism, photosynthesis, membrane transport, quantum theory, spectroscopy, elasticity, waves, fluids, electricity and magnetism, linear algebra, genomics, probability theory. 2106: Gene regulation, signal transduction, development, motility, intramolecular forces, stochastic processes, optics and microscopy, materials science, analytical tools. Restricted to majors in the College of Science. Only by permission of the instructor. Pre: 1106, 1116 for 2105; 2105 for 2106. (6H,6C)

#### 2115-2116: INTEGRATED SCIENCE LABORATORY II

Laboratory component of Integrated Science Curriculum where students conduct project-based interdisciplinary laboratories organized into content modules. 2115: Tools of Scientific Research, Genomics and Proteomics, Nanoscience, and Electromagnetism. 2116: Tools of Scientific Research, Neuroscience, Optics, and Independent Research Project. Pre: 1116 for 2115; 2115 for 2116. Co: 2105 for 2115; 2106 for 2116. (3L,1C)

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (STL)

#### 2304: LEGAL FOUNDATIONS OF INTELLECTUAL PROPERTY

Study of process of civil litigation from commencement of lawsuit through final judgment under modern statutes and rules of court, special emphasis on intellectual property lawsuits; Introduction to US intellectual property law including copyrights, patents, trademarks & unfair competition and trade secrets; Commonalities and differences among different intellectual property rights and related state and federal doctrines; Introduction to legal research and writing. Pre: (ENGL 1105, ENGL 1106) or ENGL 1204. (3H,3C)

#### 4304: PATENT LAW

The protection and enforcement of patent law, U.S. case law that interpret Sections 35 of the US Statutory Code; Analysis of the goals and cost of the patent law system; patentability requirements, infringement, remedies, patent prosecution issues, and patent transactions; Patent and intellectual property strategies. Pre: 2304.

(2H,2C)

**4314: CURRENT TOPICS IN SCIENCE, TECHNOLOGY & LAW**

This seminar course covers current developments, problems and cases at the intersection of science, technology, and law. Particular focus is placed on intellectual property law and on social, ethical and other legal issues prompted by new technologies and scientific advancements. Topics will include information privacy, fair use and plagiarism, patenting of life forms, stem cell research etc. Pre: 2304 or 4304 or 4324.

(3H,3C)

**4324: GLOBAL ASPECTS OF INTELLECTUAL PROPERTY LAW**

Comparative study of international intellectual property systems; international treaty arrangements for copyrights, patents and trademarks; protection and enforcement of intellectual property rights in foreign markets; policy analysis of the globalized intellectual property system. Pre: Senior standing.

(3H,3C)

**4334: PATENT PREPARATION & PROSECUTION**

Practice of patent law, specifically procedural and substantive laws, rules, and procedures relating to patent application, patent prosecution, and patent maintenance. Filing and prosecuting patents. Ethical issues relating to patent practice. Preparation to take US Patent and Trademark Office's (USPTO) Patent Bar Examination. Pre: 4304.

(3H,3C)

**4964: FIELD STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## College of Veterinary Medicine

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**Dean:** Cyril R. Clarke

**Associate Dean for Professional Programs:** Jennifer L. Hodgson

**Associate Dean for Research and Graduate Studies:** Roger J. Avery

**Assistant Dean for Administration:** April G. Hylton

**Associate Dean and Chairman:** Siba K. Samal

**Professors:** S. A. Ahmed, R. J. Avery, V. A. Buechner-Maxwell, G. B. Daniel, M. F. Ehrich, S. Eubank, M. O. Furr, D. R. Hodgson, J. L. Hodgson, K. D. Inzana, T. J. Inzana, M.L. Larson, M. S. Leib, D. S. Lindsay, X. J. Meng, W. E. Monroe, D. L. Panciera, K. D. Pelzer, J. P. Pickett, F. W. Pierson, K. Redican, G. G. Schurig, S. A. Smith, D. P. Sponenberg, N. Sriranganathan, K.E. Sullins, W. S. Swecker Jr., N. A. White II, W. D. Whittier, X. Zhu, J. R. Wilcke, and A. M. Zajac

**Associate Professors:** J.A. Abbott, M. Borgarelli, C. Byron, S. G. Clark, L.A. Dahlgren, L. E. Freeman, R. S. Gilley, D.C. Grant, P. N. Henao Guerrero, I. P. Herring, K. Hosig, W. R. Huckle, B. G. Klein, K. Lahmers, O. I. Lanz, Y. W. Lee, T. LeRoith, H. C. McKenzie III, D. M. Moore, N. Nanthakumar, R. S. Pleasant, U. Pal, J. Patton, J.H. Rossmeis, G. K. Saunders, W. K. Scarratt, B. J. Smith, N. Tablante, S. G. Witonsky, L. Yuan, and K. Zimmerman

**Associate Professors of Practice:** S. W. Marmagas, J. Pelzer, and V. Ragan

**Assistant Professors:** K. Abbas, I. Allen, J.G. Barrett, S. L. Barry, L.E. Bartl, G. Belov, M. E. Benitez, A. S. Bertke, K. Boes, B. A. Burgess, E. S. Champagne, C. Caswell, T. Cecere, K. S. Clapp, N. G. Dervis, J.M. Gohlke, J.Q. He, S. James-Yi, S. L. Klahn, S. M. Lahmers, S. McDonald, M. T. Nappier, D. Nelson, J. H. Neves Soares, K. Oestreich, T.E. Pancotto, N. D. Pavlisko, S.M. DeMonaco, L. A. Rios, J. D. Ruth, M. Shi, M.H. Theus, N. Weinstein, and Z. Sheng

**Research Associate Professor:** W. Eyestone

**Research Assistant Professors:** A.B.P.A. Bandara, R. Dai, J. M. Green, T. Hrubec, S. Kenney, M. R. Prater, C. Reilly, B. Rzigalinski, K. Shin-Hee, K. Sunil, and X. Yang

**Research Scientist:** N. Evans and W. Li

**Clinical Associate Professors:** J. F. Currin and A. M. Desrochers

**Clinical Assistant Professors:** J. Cecere, M. Norris Adams, R. A. Funk, S.R. Guynn, S. Hafez, D. R. Reeder, M. Shepherd, H. Schramm, and K. E. Wilson

**Clinical Instructors:** R. E. Carpenter

**Lecturer:** T. Burns and S. Wenzel

**Adjunct Faculty:** J. Bassaganya-Riera, I. Becvarova, M. J. Bowen, M. Byrnes, M. V. Crisman, J. P. Dubey, M. R. Finkler, M. A. Gomez Jaramillo, R. Gourdie, J. C. Gutierrez Toro, Q. Han, Y. Huang, J. C. Jones, T. M. Kerkering, V. Kok, L. Li, Y. Li, N. M. Lindstrom, R. MacPhail, C. J. McNeill, D.L. McRurer, M. O'Dell, O. A. Peralta Troncoso, S. L. Porter, S. Rao, B. Robert, S. Santamaria, S. Schwartz, J. Sleeman, S. J. Stahl, M. L. Tilghman, L. Tobias, R. Vemulapalli, and S.B. Barker

Web: [www.vetmed.vt.edu](http://www.vetmed.vt.edu)



## Overview

Founded by the Virginia General Assembly in 1978, the Virginia-Maryland Regional College of Veterinary Medicine is a regional school for the professional training of veterinarians which has been built upon the strong foundations of two of the nation's leading land-grant universities: Virginia Tech in Blacksburg and the University of Maryland at College Park. The College operates three campuses, including the main campus facilities at Virginia Tech, the Avrum Gudelsky Veterinary Center at College Park, and the Marion duPont Scott Equine Medical Center in Leesburg.

## Graduate Programs

The graduate program leads to the M.S. and Ph.D. in biomedical and veterinary sciences. The goal of this program is to enhance the research capabilities of the graduates so that they can conduct

independent research and associated societal endeavors aimed at solving biomedical problems related to veterinary medicine. These individuals will be expected to make scientific contributions in academia, research, and animal health administration.

For additional information, contact the Graduate School via e-mail at [vmsgrad@vt.edu](mailto:vmsgrad@vt.edu).

## Professional Program

Students desiring admission to the four-year instructional program leading to the D.V.M. degree must show evidence of intellectual ability and achievement, as well as personal preparation for the curriculum and the profession. Because the number of applicants greatly exceeds the number of spaces in entering classes, only those who demonstrate such qualifications to a high degree will be selected. Most entering students will have completed three or more years at an accredited university by the time of matriculation; however, applications will be accepted from students who have completed at least 60 semester hours or 90 quarter hours of university credit by the end of the spring term of the year for which application is being made, and who have a grade point average of at least 2.8 on a four-point scale. Exceptional students with the minimum university course work are encouraged to apply.

A number of college courses, with laboratory classes, are required for entry into the DVM program including biological sciences, organic chemistry, and physics. An 8-semester-hour or 12-quarter-hour sequence is required for each of these subjects. A one-semester course (3 semester hours) in biochemistry will meet the minimum requirement for entry.

Further courses required include 6 semester hours or 9 quarter hours of college-level courses in English, mathematics, and humanities/social sciences. In addition, many courses contributing to a well-rounded liberal education are of direct value and, although proficiency in the sciences is essential to the understanding of veterinary medicine, concentration on the sciences at the undergraduate level is not essential. Those students who elect to major in disciplines other than the biological sciences, chemistry, or physics may find less difficulty in coping with the basic sciences in veterinary medical school if they have, in addition to the above mentioned required courses, some work in either advanced biology or advanced chemistry. Suggested electives include: medical terminology, biostatistics; cell biology, comparative anatomy, genetics, microbiology, nutrition, physiology, or domestic animal production courses. Since veterinary medicine also is concerned with a variety of social, environmental, and community activities, a broad cultural background is important. Basic computer skills are highly desirable.

### **Admissions inquiries should be directed to:**

Jacque Pelzer, D.V.M.  
Director of Admissions and Student Services

Ms. Shelby Jenkins  
Admissions Coordinator

Admissions Office  
Virginia-Maryland Regional College of Veterinary Medicine  
Virginia Tech  
Blacksburg, VA 24061  
Phone: (540) 231-4699  
E-mail: [dvadmit@vt.edu](mailto:dvadmit@vt.edu)  
Web: [www.vetmed.vt.edu](http://www.vetmed.vt.edu)

## Public Health Program

Virginia Tech's Public Health Program in the Department of Population Health Sciences is administered by the Virginia-Maryland College of Veterinary Medicine in partnership with the Virginia Tech Carilion School of Medicine and is accredited by the Council on Education for Public Health.

The Master of Public Health professional degree program integrates and expands public health offerings at Virginia Tech and enhances the university's track record of addressing vital public health issues through learning, discovery, and engagement.

The program is grounded in an interdisciplinary "One Health" approach. One Health recognizes the dynamic interdependence of human, animal, and environmental health and encompasses the interdisciplinary efforts of medical, veterinary, environmental health, and public health professionals to protect, promote, and improve health. Students gain the requisite knowledge and skills to examine the human, animal, and environmental factors that contribute to the control and prevention of disease and the promotion, enhancement, and maintenance of health.

For additional information, please contact the Public Health Program at [phs@vt.edu](mailto:phs@vt.edu) or by phone at (540) 231-3945.

## Professional Program Courses

Professional program courses leading to the D.V.M. degree carry the veterinary medicine (VM) prefix. For updated information on the DVM Curriculum, please see our website at:

<http://www.vetmed.vt.edu/academics/dvm/dvm-curriculum.asp>.

8164: Normal Animal  
8174: Dealing with Threats  
8184: Becoming a Professional I  
8234: Fundamentals Of Nutrition  
8254 (BMVS 5814): Functional Morphology Birds, Reptiles  
8264: Small Animal Nutrition  
8274: Topics In Veterinary Pharmacology  
8284: Veterinary Musculoskeletal System  
8304: Veterinary Pathology I  
8314 (BMVS 5244): Fundamentals Of Veterinary Pharmacology  
8324 (BMVS 5744): Veterinary Parasitology  
8334 (BMVS 5754): Veterinary Bacteriology & Mycology  
8344: Veterinary Ophthalmology  
8354: Veterinary Clinical Techniques  
8374: Fundamentals of Theriogenology  
8384: Food Animal Nutrition  
8394 (BMVS 5844): Equine Nutrition  
8404: Veterinary Pathology II  
8414 (BMVS 5734): Clinical Pathology  
8424 (BMVS 5254): Veterinary Toxicology  
8434: Veterinary Public Health  
8444: Veterinary Anesthesiology  
8454: Veterinary Clinical Nutrition  
8474: Reproductive Pathology  
8485-8486-8487: Bovine Reproductive Management  
8494: Aquatic Medicine/Fish Health  
8514 (BMVS 6514): Equine Theriogenology  
8524: Equine Clinical Problem Solving  
8534 (BMVS 5564): Introduction To Clinical Research  
8544: Veterinary Radiology  
8554: General Veterinary Medicine  
8574: Food Animal Theriogenology  
8585, 8586, 8587: Small Animal Medicine

8594: Wildlife Medicine  
8614: Veterinary Gastroenterology  
8615, 8616: Food Animal Medicine And Surgery  
8624: Veterinary Surgical Principles and Practicals  
8644: Urology  
8654: Veterinary Neurology  
8674: Vet Hemolymphatic System  
8684 (BMVS 6554): Advanced Epidemiology  
8694: Advanced Small Animal Techniques  
8695, 8696: Equine Medicine And Surgery  
8754 (BMVS 5864): Veterinary Cardiorespiratory System  
8764: Veterinary Dermatology and Endocrinology  
8784: Clinical Pharmacology  
8804: Complementary Medicine  
8874: Ferret Medicine & Surgery  
8984: SS-Professional Foundations  
8984: SS-Professional Foundations II  
8984: SS-Veterinary Genetics  
8984: SS-Vets in Global Community  
8984: SS-Beef Cow-Calf Institute  
8984: SS-Professional Foundations III  
8984: SS-Professional Foundations IV  
8984: SS-Emerging & Exotic Dis of An  
8984: SS-Veterinarians & Public Policy  
8984: SS-International Clinical VM  
8984: SS-Professional Foundations V  
8984: SS-Public Corp Problem Solving  
8984: SS-SA Behavioral Medicine  
8984: SS-Parasitology of Grazing Animals  
8984: SS-Equine Field Services Clerkship  
8984: SS-Dairy Herd Mgmt Clerkship  
8984: SS-Beef Herd Mgmt Clerkship  
8984: SS-CVM Externship Clerkship  
8984: SS-Federal/State Government  
8984: SS-Research/Diagnostics  
8984: SS-Institutional Applied Clinical Med  
8984: SS-Corporate/Associate/Admin  
8984: SS-International Public Corporate  
8984: SS-Oncology Clerkship  
8984: SS-Therigenology Clerkship  
8984: SS-SA Emergency Medicine  
8984: SS-Equine Podiatry  
9004: Avian Medicine And Surgery  
9034: Advanced Small Animal Surgery  
9044: Food Animal Clinical Problem Solving  
9064: Advanced Histopathology  
9074: Goat And Sheep Medicine  
9085-9086 (BMVS 5005-5006): Emerging Infectious Diseases  
9094 (BMVS 6564): Advanced Veterinary Public Health  
9124: Advanced Equine Therigenology  
9134: Advanced Small Animal Surgery Lab

9144: Problem Solving In Small Animal Medicine  
9174: Equine Neonatology & Pediatrics  
9224: Clinical Applications In Exotic Animal Medicine  
9254: Small Animal Theriogenology  
9264: Small Animal Community Practice Clerkship  
9404: Specialty Medicine Clerkship  
9424: Avian Medicine Elective Clerkship  
9434: Small Animal Medicine Clerkship  
9454: Veterinary Ophthalmology Elective Clerkship  
9504: Large Animal Clinical Services Clerkship  
9534: Production Management Medicine Clerkship  
9544: Equine Medical Center Clerkship  
9574: Production Mgt Medicine Elective Clerkship  
9594: Theriogenology Elective Clerkship  
9604: Sm. Ruminant/Pseudoruminant Elec. Clerkship  
9614: Small Animal Surgery Clerkship  
9624: Anesthesiology Clerkship  
9634: Radiology Clerkship  
9644: Small Animal Private Practice Clerkship  
9714: Govt & Corp. Veterinary Medicine Clerkship  
9724: Laboratory Services Clerkship  
9744: Morphologic Pathology Elective Clerkship  
9804: Food Animal Private Practice Clerkship  
9814: Equine Private Practice Clerkship  
9824: Mixed Species Private Practice Clerkship  
BMVS 4014: Animal Domestication  
BMVS 4024: Diseases of Poultry  
TBA: Cardiology Clerkship  
TBA: Dermatology Clerkship  
TBA: Neurology Clerkship

## Undergraduate Courses (BMVS)

### 4014: ANIMAL DOMESTICATION AND GENETIC RESOURCES

Considers the process, history, sociology and geography of animal domestication. Includes behavioral, physiologic and morphological changes incurred by domesticated stocks. Examines genetic variability of domestic species, considers breed groups and uniquely adapted breeds. Considers reasons for erosion of genetic variability and mechanisms to counteract such erosion. International in scope. Pre: senior status or enrollment in veterinary professional curriculum.

(1H,1C)

### 4024: DISEASES OF POULTRY

Biology control and prevention of poultry diseases. Taught alternate years.

(2H,2C)

### 4034 (BCHM 4034): ENVIRONMENTAL HEALTH TOXICOLOGY

Health effects associated with the exposure to chemicals, identifying and managing problems of chemical exposure in the work places and the environment, fundamental principles of biopharmaceutics and toxicokinetics, and risk assessment. Emphasis on conceptual understanding of chemical entry into the body, biotransformation, or degradation multiple chemical sensitivity, and chemically induced diseases. Identification of nutrient interactions with environmentally induced disorders and to understand the mechanisms of such interactions and their influence on human health and welfare. Pre: BIOL 2104 or BIOL 3124, ALS 2304 or BIOL 2406 or BCHM 3114.



(3H,3C)

#### 4054: LABORATORY ANIMAL MANAGEMENT

This 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 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, the course is designed to complement graduate studies in biological, biomedical, and life sciences which involve the use of animals in research. (2H,3L,3C)

#### 4064 (BMES 4064): INTRODUCTION TO MEDICAL PHYSIOLOGY

An introductory course to the principles of medical physiology, designed primarily for -- but not limited to -- undergraduate and graduate students majoring in biomedical engineering, and other related engineering and physical sciences majors with little or no formal background in biological sciences. The focus is on basic principles and concepts of physiology with a special emphasis on the interactions of human systems biology in their entirety rather than individual genes and pathways. Not intended for students expecting to major in biology or planning to enter health professional fields. Pre: Junior standing or permission of the instructor.

(3H,3C)

#### 4074: PHARMACOLOGY

A basic course in the science of pharmacology, intended to provide an understanding of the mechanisms of action and physiological systemic effects of major classes of drugs of biological, agricultural, social, and medical importance. Must have prerequisites or equivalent. Pre: CHEM 2514 or CHEM 2535 or ALS 2304 or BIOL 2406.

(3H,3C)

#### 4084 (VM 9204): 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 effects 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. Pre: third year standing in DVM curriculum. Pre: (CHEM 2514 or CHEM 2535), (BIOL 2406 or ALS 2304), (MATH 1015 or MATH 1014).

(2H,2C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors section Variable credit course.

## Undergraduate Courses (BMSP)

#### 2135-2136: HUMAN ANATOMY & PHYSIOLOGY

Structure and function of the human body for students preparing for professions in the health fields. 2135: body plan and organization, homeostasis, cell structure and function, histology, integumentary system, skeletal system, muscular system, nervous system and special senses. 2136: endocrine system, circulatory & cardiovascular system, lymphatic system and immunity, respiratory system, digestive system, metabolism, excretion, reproduction, and development. BMSP 2135-2136 duplicates BIOL 2405-2406; may not receive credit for both. Pre: (BIOL 1005 or BIOL 1006) or (BIOL 1105 or BIOL 1106) or

(BIOL 1205H or BIOL 1206 H) for 2135; 2135 for 2136.  
(3H,3C)

#### 2145-2146: HUMAN ANATOMY AND PHYSIOLOGY LABORATORY

Laboratory exercises investigating the structure and function of the human body for students preparing for professions in the health fields. 2145: body plan and organization, homeostasis, cell structure and function, histology, integumentary system, skeletal system, muscular system, nervous system and special senses. 2146: endocrine system, circulatory & cardiovascular system, lymphatic system and immunity, respiratory system, digestive system, metabolism, excretion, reproduction, and development. BMSP 2145-2146 duplicates BIOL 2414; may not receive credit for both. Co: 2135 for 2145; 2136 for 2146.  
(3L,1C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Courses (PHS)

#### 1514: PERSONAL HEALTH

Fundamental health content and theory to provide students with constructive health information necessary to meet current and future personal health needs. Special emphasis on wellness and health promotion.  
(3H,3C)

#### 3014: INTRODUCTION TO ENVIRONMENTAL HEALTH

Overview of environmental health, examining local, national, and international frameworks. Environmental factors that affect human health, including major classes of chemical, biological, and physical exposures from different environmental media (air, water, food, and soil). Special emphasis on toxicology and epidemiology methodologies used at the individual (mechanistic) level and at the population level to determine environmental causes of disease. Find the most appropriate prevention or control measure to minimize adverse health outcomes. (3H,3C)

#### 3064: PUBLIC HEALTH SEMINAR

Current topics in public health research, policy and practice, including biostatistics, epidemiology, health policy, environmental health, social and behavioral medicine, infectious diseases, and public health education. Pass/Fail only. Pass/Fail only. (1H,1C)

#### 3534: DRUG EDUCATION

Interpretation of multidimensional (social, psychological and physiological) scientific data regarding drugs. The major drug categories will be covered with special emphasis on substance misuse and abuse.  
(3H,3C)

#### 4044: PUBLIC HEALTH POLICY AND ADMINISTRATION

Evolution and analysis of public health policy in the United States. Public health and care systems. Administrative concepts central to public health such as human resources, strategic planning, controlling, directing, leadership and health law. Junior Standing. (3H,3C)

#### 4054: CONCEPTS IN ONE HEALTH

One Health refers to the dynamic interdependence of human, animal and environmental health and provides an important perspective in examining health problems. Theoretical foundations of One Health, methods for assessing animal- human linkages, policies and practices related to One Health and capacity building and public engagement. Junior Standing. (3H,3C)

#### 4984: SPECIAL STUDY

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Agricultural and Applied Economics

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[Undergraduate Course Descriptions \(AAEC\)](#)

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**Head:** Steven C. Blank

**Professors:** J.R. Alwang, D.J. Bosch, K.J. Boyle, R. Crowder, G. C. Davis, M.J. Ellerbrock, L.L. Geyer, R.H. Lytton, M. A. Marchant, B.F. Mills, G. W. Norton, M. Norton, J. Pease, E.B. Peterson, K. Stephenson, and D.B. Taylor

**Associate Professors:** G.E. Groover, A. Marathe, and K. Moeltner

**Assistant Professors:** K. Boys, J.H. Grant, H. Smith, and W. You

**Instructors:** G. Ferreira and W.A. White

**Career Advisor:** K. Stephenson

Web: <http://www.aaec.vt.edu>

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Major Options

- B.S. in Agribusiness w/ Agribusiness Management Option (AGBM)
- B.S. in Applied Economic Management w/ Environmental Economics, Management, and Policy Option (EEMP)
- B.S. in Applied Economic Management w/ International Trade and Development Option (ITD)
- B.S. in Applied Economic Management w/ Community Economic Development Option (CED)
- B.S. in Agribusiness w/ Veterinary Business Management Option (VBMG)
- B.S. in Applied Economic Management w/ Financial Planning Option (FNPN)

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the degree can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (AAEC)

### 1005,1006: ECONOMICS OF THE FOOD AND FIBER SYSTEM

Economic principles that underlie functioning of the U.S. economy in general, and the food and fiber system in particular, are developed and applied to analysis of issues important to society. Emphasis on interrelationships of U.S. micro-economic and macro-economics policy, agriculture, and economic well being of world society in terms of availability and price of food and fiber, use of natural resources, and development of rural economics. I,II. (3H,3C)

### 1264: PEACE ECONOMICS

Introduction to economic impediments and solutions in the pursuit of world peace, including various perspectives on defining peace, the role of natural resources and ethics in regional and global development, and the actual poverty reduction programs. (3H,3C)

### 2104 (FIN 2104): PERSONAL FINANCIAL PLANNING

Survey of fundamental personal financial planning needs and decisions of young professionals. Introduction to the personal financial planning needs that special household circumstances or non-traditional household situations may precipitate. (3H,3C)

### 2424: COOPERATIVES AND THEIR IMPACT ON THE HUMAN CONDITION

An assessment of the member-owned cooperative organizational structure, including the founding Rochdale Principles (circa 1842) and how these principles and ethics are still prevalent in modern-day cooperatives. Emphasis will be on both agricultural (supply, marketing, service) and non-agricultural (employee-owned, rural electric, housing, child care, health care, crafts, credit unions) cooperatives, with special attention to the impacts on the human condition. I (3H,3C)

### 2434: FOUNDATIONS OF AGRIBUSINESS

Introduction to the primary management tools as they relate to farm production enterprises and agribusinesses. Principles and concepts of preparing farm and agribusiness financial statements and their analysis. Application of budgeting and risk management. Pre: 1005. (3H,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3004: AGRICULTURAL PRODUCTION AND CONSUMPTION ECONOMICS

The economic principles of production. Applications to decision-making and the allocation of resources for the agricultural firm. Consumer behavior and demand for agricultural products. Pre: 1005. (3H,3C) II.

#### 3014: ANALYTICAL METHODS IN APPLIED ECONOMICS

Quantitative methods used in applied empirical economic analysis including simple and multiple regression, estimation and application of elasticity, decision analysis, economic simulations, linear programming, and risk analysis. Analysis using spreadsheets stressed. Pre: STAT 3005 or BIT 2405 or STAT 3615. (3H,3C)

#### 3015-3016: INTERNSHIP IN AGRICULTURAL AND APPLIED ECONOMICS

Preparation for, and follow-up to, a practical experience in a selected agricultural, resource, or governmental enterprise, which takes place under the direct supervision of an owner, manager, or supervisor. 3015: offers the student a broad management horizon on understanding the value and the process of setting goals and objectives, and provides methods for evaluating one's abilities, interests, and desires for making career-path choices. 3016: provides a forum for students to share work experiences, discuss human resource issues, and apply the problem solving process to a problem or concern witnessed during the internship. 3015: II; 3016: I. (1H,1C)

#### 3024: MONETARY AND GLOBAL ISSUES IN APPLIED ECONOMICS

Economics of an open economy and its impact on agricultural and natural resource markets. History of the monetary system, national accounts, balance of payments, fiscal and monetary policy, foreign exchange determinants, trade deficits, international finance, globalization and economic growth. Linkages to agricultural policy and commodity markets stressed. Pre: 1005, 1006. (3H,3C)

#### 3104: FINANCIAL PLANNING FOR PROFESSIONALS

Analysis of financial needs, from the context of the individual, household or small business owner, related to financial situation (cash management and use of debt), income taxes, risk management, retirement planning, investment planning, estate planning, and other special needs. Utilizes mathematical and computing skills. FIN students may be excused from the AAEC 2104 pre-requisite with instructor permission. Pre: 2104, FIN 3134. Co: FIN 3134. (3H,3C)

#### 3204: INTERNATIONAL AGRICULTURAL DEVELOPMENT AND TRADE

Examination of the role of agriculture in less developed countries and how that role is affected by public policies. Topics include the dimensions of world food, population, and income problems; theories of economic development and the role of agriculture; a description of traditional agricultural systems and their evolution; components of an agricultural modernization strategy; the impacts of international trade and aid; and the effects of international development on U.S. agriculture. I Pre: 1005, 1006. (3H,3C)

#### 3314: ENVIRONMENTAL LAW

Principles of law involved in environmental issues, survey of environmental litigation, legislation and administrative rulings. Law topics include natural resources, water pollution, private land use, air pollution, toxic substance, food, drug, pesticides, and biotechnology. (3H,3C) II.

#### 3324: ENVIRONMENT AND SUSTAINABLE DEVELOPMENT ECONOMICS

Economics of environment and sustainable development. Topics include economic efficiency, property rights, externalities, benefit-cost analysis, economic evaluation procedures, public and private conflicts in land use, water quality, and international growth/development/environmental issues. Pre: 1005 or ECON 2005. (3H,3C)

#### 3454 (MGT 3454): SMALL BUSINESS MANAGEMENT AND ENTREPRENEURSHIP

Characteristics of small business and entrepreneurs, and their economic importance. Development and operation of a small business, including concepts and principles such as franchising, business plans, capital acquisition, venture capital, financial and administrative control, marketing, human resource and operations management. Taxation, legal, insurance and ethics in small business. Pre: 2434 or ACIS 2115

or MGT 3064. (3H,3C)

#### 3504: MARKETING AGRICULTURAL PRODUCTS

Structure of the agricultural marketing system with emphasis on factors determining farm level prices. Emphasis on how markets coordinate consumer desires and producer costs through marketing channels. Impact of market structure, grades, information, product form, and advertising on farm prices. International trade impacts on producers, consumers, agribusiness, and government. I Pre: 1005. (3H,3C)

#### 3514: AGRICULTURAL FUTURES AND OPTIONS

The role of agricultural futures and options in risk management strategies for producers and agribusiness firms and in the price discovery process. Fundamental supply-demand and technical analysis of the markets and pricing processes. Development and applications of effective price risk management strategies. (3H,3C) II.

#### 3604: AGRICULTURAL LAW

Legal problems of farm and agribusiness management. Practical application of principles of contracts, negligence, debt instruments and commercial transactions of the farm and agribusiness organization. Selected state and federal laws regulating the farm and agribusiness sector; basic animal laws including state and federal regulation of agricultural sector. I (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4104: RETIREMENT PLANNING

Overview of planning needs, products, and strategies used by financial professionals to help businesses, small business owners, and individuals choose and implement an effective retirement plan. Must have prerequisite or permission of instructor. Pre: 3104. (3H,3C)

#### 4114 (FIN 4114): FINANCIAL PLANNING TECHNOLOGY & MODELING

Use of professional software applications that support financial planning analyses, plan preparation, wealth management, and client relationships. Principles of personal investment portfolio research, construction, and performance applied to comprehensive financial planning and wealth management. Pre: 3104, FIN 3144. (3H,3C)

#### 4124: CLIENT RELATIONSHIP MANAGEMENT

Investigation of socio-psychological factors and communication/interviewing strategies that foster trust-based relationships essential to the success of financial advisors and other financial service professionals. Graduate students are expected to have completed AAEC 3104 or an equivalent course or may enroll with permission of the instructor. Pre: 2104 or 3104. (3H,3C)

#### 4134: FINANCIAL PLANNING APPLICATIONS

Integration of financial planning content in the resolution of client situations in the context of ethical and compliant workplace practices. Utilizes a case analysis approach applying financial planning processes and procedures. Graduate students are expected to have similar background from equivalent courses or professional experience or may enroll by permission of the instructor. ACIS 4344 or FIN 4004 taken simultaneously with this course can be substituted for the pre-requisites. Pre: 3104, 4104, FIN 3144, FIN 3204. (3H,3C)

#### 4135 (ECON 4135): INTERNATIONAL ECONOMICS

4135 International Trade: Factor mobility and commercial policy (tariffs, quotas, export licensing). Pre: ECON 3104 or ECON 2025H or AAEC 3004. (3H,3C)

#### 4204: FOOD AND AGRICULTURAL POLICY

Examination of the role of agriculture in developed economies and how agriculture is affected by policy decisions in the public sector. Emphasis will be placed on the economic impacts of policies on the producers and consumers of agricultural products: price supports, food stamps, tariffs and quotas. I Pre: 1005, 1006. (3H,3C)

#### 4314: ENVIRONMENTAL ECONOMIC ANALYSIS AND MANAGEMENT

Quantitative methods and computer-aided tools used in the economic analysis of environmental/natural resource issues. Economic concepts and analytical tools will be applied to realistic, problem-solving situations. Topics include cost effectiveness analysis, benefit-cost analysis, economic simulations, and statistical analysis. Pre: 3324 or ECON 4014 or FOR 3424 or FREC 3424. (3H,3C) II.

#### 4324: RURAL AND REGIONAL DEVELOPMENT POLICY

Description of rural areas, their economic structure, and conditions for broad-based economic development. Emphasis on the role of markets in the development process. Introduction to tools to evaluate policies and programs, identify distributional impacts, identify appropriateness for long-term sustainable development, and analyze tradeoffs between policy goals. Alternatives to public financing in rural areas. Pre: 1005, 3004. (3H,3C)

#### 4334: APPLICATIONS RURAL DEVELOPMENT

Evaluation of policy alternatives and programs for the development of rural areas. Intensive use of analytical techniques, including spreadsheet analysis of trends and changes over time, shift-share analysis of economic change, creation of indices of distribution and poverty for rural areas, creation and use of economic base multipliers, construction, use and interpretation of input-output models. Pre: 1005, 3004. Co: 4324. (1H,1C)

#### 4344: SUSTAINABLE DEVELOPMENT ECONOMICS

Sustainable development concepts are critically explored particular emphasis on implications for domestic and international sustainable development agriculture and for economic development. Students investigate case studies illustrating problems of sustainable development and potential policy solutions. I Pre: (3324 or 3004 or ECON 4014). (3H,3C)

#### 4404: AGRICULTURAL MANAGEMENT AND PROBLEM-SOLVING

Capstone course for students interested in agribusiness management. Application of concepts, tools, and principles including management, finance, marketing, economic theory, and quantitative methods to applied agricultural decisions. Application of knowledge on selected agricultural projects that enhance team-building, written, and oral communication skills. Senior Standing required. Pre: 3454. (3H,3C) II.

#### 4424: AG FINANCIAL MANAGEMENT

Principles and concepts of preparing agricultural financial statements. Analysis of these statements following professional farm financial guidelines. Economic concepts applied to management of agricultural enterprises. Leasing, purchasing, borrowing, and lending decisions in agriculture. Agricultural applications of budget, risk management and mitigation, and loan structuring. Pre: 1005, 2434, FIN 3104. (3H,3C)

#### 4464 (FREC 4464): WATER RESOURCES POLICY & ECON

Economic concepts to understand public and private decisions about water use. Current water policies and law. Analytical tools to evaluate policies and address management challenges. Water markets, climate change, and environmental flows. Pre: 1005. (3H,3C)

#### 4504: AGRICULTURAL PRICE AND MARKET ANALYSIS

Estimation of agricultural supply, demand, and price relationships. Determination of market potential for new products. Students identify problem, collect data, estimate statistical relationship(s), interpret results, and write research report. Use of probability distribution in marketing strategy development. I Pre: 3004, STAT 3005, STAT 3615, BIT 2405. (3H,3C)

#### 4514: ADVANCED AGRIBUSINESS MARKETING

Applying concepts, principles, and analytical tools in developing a marketing plan for an existing or new agricultural product or service. Students will define the market, perform competitive marketing analysis, outline market assumptions and objectives, and perform a three-year financial evaluation of the action plan. Course can be repeated once. Co: 3504 or 3004. I Variable credit course. Pre: 2434, 3504.

#### 4754: REAL ESTATE LAW

The law of real property, legal framework, law of estates in land, conveyancing, landlord-tenant and non-possessory interest in real property. Zoning, easements, restrictive covenants. Mortgages, deeds of trust, and taxation of real estate. Junior standing required. I (3H,3C)

#### 4764: REAL ESTATE APPRAISAL

Application of economic principles to the valuation and appraisal of property. Income, cost and comparable approach to value. Rural property, commercial, residential and transitional will be evaluated. Ethical and professional requirements. Variable lab credit available to meet Real Estate licensing requirements. (Course credits may vary from 3 to 5 hours.) Junior standing required. Variable credit course. II.

#### 4804 (STAT 4804): ELEMENTARY ECONOMETRICS

Economic applications of mathematical and statistical techniques: regression, estimators, hypothesis testing, lagged variables, discrete variables, violations of assumptions, simultaneous equations. Pre: 1006, (STAT 3005 or STAT 3604). (3H,3C) II.

#### 4814: FOOD AND HEALTH ECONOMICS

Microeconomics of food, nutrition, and health. Overview of nutrition, nutrition recommendations, and implications for economics based decisions. Individual and household food consumption and health production models. Farm to consumer market linkage models with nutrition and health implications. Effectiveness of food and nutrition interventions and policies. Cost-benefit and cost-effectiveness analysis of health interventions. Pre-requisite: Senior Standing required. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Accounting and Information Systems

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[Course Requirements](#)

[Accounting Option \(ACCT\)](#)

[Information Systems Audit Option \(ISA\)](#)

[Information Systems Option \(ISO\)](#)

[Undergraduate Course Descriptions \(ACIS\)](#)

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**Head:** John J. Maher

**R. B. Pamplin Professor of Accounting and Information Systems:** F. Belanger

**Curling Professor of Accounting and Information Systems:** W. E. Seago

**John E. Peterson, Jr. Professor of Accounting and Information Systems:** J. G. Jenkins

**John F. Carroll, Jr. Professor of Accounting and Information Systems:** J. J. Maher

**Professors:** R. Barkhi, W. Fan, J.G. Jenkins, and S.D. Sheetz

**Associate Professors:** S. Bhattacharjee, J.A. Brozovsky, D.A. Salvador, D.P. Tegarden, and L.G. Wallace

**Assistant Professors:** B.D. Beyer, M. Cobabe, D. Godsell, T.B. Hansen, C. Hayne, J. Huang, E.S. Johnson, K.W. Smith, S.E. Stein, and M.C. Wolfe

**Assistant Professor of Practice:** L.A. Almond

**Associate Professor of Practice:** N.A. Rogers

**Instructors:** C.M. Easterwood, D.P. Garner, J.M. Lacoste, E.A. Martin, J.P. Sharp, and J.L. Shortt

**Career Advisor:** J. Maher (231-6591)

Web: [www.acis.pamplin.vt.edu](http://www.acis.pamplin.vt.edu)



## Our Mission

The Department of Accounting and Information Systems in the Pamplin College of Business strives for excellence in fulfilling the three missions of a comprehensive land grant university by:

- Improving the accounting and information systems professions by conducting quality research and disseminating the results;
- Providing a world class accounting and information systems education to our students; and
- Delivering outreach services to accounting and information systems professionals and educators.

The department seeks to fulfill the teaching mission through programs which include:

**Undergraduate Programs**, where we seek to

- *Prepare students to enter the accounting and information systems professions with the skills and knowledge of business, information systems, and accounting concepts and practices.*

**Masters of Accounting and Information Systems**, where we seek to

- *Prepare students for professional careers with specializations in taxation, information systems, audit, and financial services.*

**Ph.D. Program in Business with a major in Accounting and Information Systems**, where we seek to

- *Prepare students for academic careers in research and teaching.*

The Department of Accounting and Information Systems prepares students to become professionals in their chosen area of accounting and information systems. Faculty members in the department have chosen to specialize in selected areas of accounting or information systems and they teach and conduct research in these areas. All faculty members at the professorial ranks have Ph.D.s in accounting or information systems appropriate to the courses they teach, and many have professional certification in their areas of specialization. This faculty is committed to the education of accounting and information systems professionals who will be active participants in this information age, with increasing demand for data analytics skills.

The department's undergraduate program offers three options: Accounting (ACCT), Information Systems Audit (ISA), and Information Systems (ISO). These options are designed to allow students to specialize in

their area of interest. Completion of the selected option prepares the student for entry level positions as professional accountants or information systems professionals who work in professional service firms, industrial companies, governmental entities, or to continue their education in graduate school. The job titles vary greatly and include auditor, information systems auditor, management accountant, tax preparer, systems consultant, systems analyst, controller, financial data analytics specialist, and cost analyst. The demand for our graduates has been strong throughout the department's history, and that demand is continuing.

Many graduates of our department desire to gain certification in their selected area of specialization. The Certified Public Accountant (CPA) is the best known of these certifications. Students taking the CPA exam in Virginia have to meet a 120-hour baccalaureate or higher degree requirement in order to sit for the CPA exam, but must have 150 credit hours to be certified. The requirements for other states vary; however, most now or soon will require students to meet the 150-hour educational requirement to be licensed. Students should discuss with their advisor the several options Virginia Tech provides for meeting this requirement at both the undergraduate and graduate level. In addition to the CPA exam, graduates of our programs sit for the Certificate in Management Accounting (CMA) exam, the Certified Internal Auditor (CIA) exam, the Certified Information Systems Auditor (CISA) exam, and others. Students planning to take one of these exams are advised to talk to their department's faculty during their junior year so that they may select the electives appropriate for the selected exam.

The department encourages its students to gain "real world" **experience** prior to graduation through an internship or by participating in the Cooperative Education Program. More information about these programs is available either from the department's faculty or Career Services. The department supports winter internships for seniors who enroll in the 152-hour program.

The department also encourages **interaction with accounting and information systems professionals** by sponsoring three student organizations: Accounting Society; National Association of Black Accountants; and Beta Alpha Psi, the national honorary and professional society dedicated to the advancement of the accounting profession. These organizations and other campus groups provide multiple opportunities for developing leadership skills and interacting with accounting and information systems professionals.

The department encourages students to gain a **global perspective** of business through modules on international issues in our courses, by participation in the college's International Business Minor and/or by participating in one or more of the college's study abroad programs. Our goal is to encourage our students to become well-rounded professionals who will become leaders in their chosen careers.

Lastly, the department's over 6,500 alumni have generously contributed to a variety of scholarships for accounting and information systems majors. Each year the department awards over \$200,000 in scholarships to our students.

## Course Requirements

Students graduating from the Department of Accounting and Information Systems must have a minimum quality credit average (GPA) of 2.00 in upper-division (3000 and 4000 level) accounting and information systems courses (the in-major GPA) as well as an overall GPA of 2.00 for all courses taken at Virginia Tech.

During their sophomore year, students must select one of the three options in the department: Accounting (ACCT), Information Systems Audit (ISA), and Information Systems (ISO). These options are more fully described below.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all

requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Accounting Option (ACCT)

The Accounting option provides basic education for careers in public accounting, internal auditing, large and small corporations (controller's staff), governments (federal, state, and local) and their agencies, and nonprofit organizations. Graduates from this option are prepared to become CMAs, CIA, CPAs, and all of the other common professional accounting designations. Many of the students who select this option will continue into the Master of Accounting and Information Systems program.

## Information Systems Audit Option (ISA)

The IS Audit option is designed to prepare students for careers as information systems auditors and information systems professionals in the areas of enterprise risk assurance services, computer risk management services, and other systems assurance services. These positions are available in organizations from all sectors of business: industry, professional service firms, consulting firms, government, and nonprofit organizations. This track prepares graduates to sit for the CIA, CPA, CISA, or other professional designations.

## Information Systems Option (ISO)

The Information Systems option (ISO) is designed to be flexible, thus allowing the student to focus on different areas of information systems. The flexibility is provided through the 12 hours of ACIS electives required in the program. Depending upon the electives selected, the student is prepared for careers such as systems analysts, database administrators, systems developers, information systems auditors, consultants, and other information systems professionals. These positions are available with organizations from all sectors of business: industry, professional service firms, consulting firms, government, and nonprofit organizations. This option prepares graduates to sit for CIA, CISA, or other professional designations.

## Undergraduate Course Descriptions (ACIS)

### 1004: ACCOUNTING FOUNDATIONS

Fundamentals of accounting, the language of business, including what accounting information is, how it is developed, how it is used and what it means. Financial Accounting including the application of accounting principles for real world, complex business transactions to classify these transactions, reflect their economic value, produce basic financial statements, evaluate financial position and make fundamental interpretations. Managerial Accounting including cost behaviors, budgeting and other management reporting to assist in internal decision making and performance analysis. Attention to accountants' codes of ethics applied throughout. Emphasis placed on non-Business majors becoming informed users of accounting information. No credit will be given for ACIS 1004 if taken with or after ACIS 2115 or ACIS 2116. (3H,3C)

### 1504: INTRODUCTION TO BUSINESS ANALYTICS & BUSINESS INTELLIGENCE

Introduction to Business Information Systems with emphasis on the role of software applications as a tool to develop Business Intelligence to improve decision making. Design and development of spreadsheet and database solutions employing analytical techniques on large data sets to produce quality information. Ethical considerations of information management. (3H,3C)

#### 2115-2116: PRINCIPLES OF ACCOUNTING

Comprehensive presentation of basic principles of financial and managerial accounting including origin, purpose, and effect with emphasis on application. Sophomore standing required. (3H,3C)

#### 2504: PERSONAL COMPUTERS IN BUSINESS

Focuses on the design and implementation of spreadsheet projects that support advanced decision-making and problem-solving techniques for professionals and individual business users. An introduction to programming logic is included to allow students to augment and automate spreadsheets. Students enrolling in this course are expected to be familiar with basic spreadsheet skills including spreadsheet navigation, managing multiple worksheets, formatting, formulas, and cell references. Pre: 1504, 2115. (3H,3C)

#### 2954: BUSINESS STUDY ABROAD

This course provides students with an international business experience. The course examines the accounting and information systems issues that impact the multinational business. It is only offered as part of a program outside of the United States. Students will learn from the structured educational experience developed by the faculty leader. Content will vary between semesters. Pre: Instructor's consent and the completion of 24 semester hours with a minimum GPA of 3.0 or departmental consent. May be repeated for a maximum of 9 credit hours. Variable credit course.

#### 3115-3116: INTERMEDIATE FINANCIAL ACCOUNTING

In-depth analysis of basic concepts of external financial reporting. Includes transaction analysis and preparation of financial statements. Pre: 2115, ECON 2005 for 3115; 3115 for 3116. Co: 2504 for 3115. (3H,3C)

#### 3314: TAX IMPACT ON DECISIONS

An analysis of the impact of taxation on business and investment decisions, and the importance of effective tax planning. The course develops a conceptual framework that integrates tax and non-tax factors into decision models. Topics to be covered include basic tax planning strategies, tax policy, an overview of basic tax concepts and terminology, implicit taxes and tax clientele theory, choosing the optimal organizational form, multilateral tax planning in contexts such as executive compensation, and multi-jurisdictional tax issues. Pre: 2116. (3H,3C)

#### 3414: AUDITING, GOVERNANCE, AND PROFESSIONAL ETHICS

The purpose of this course is to introduce the accounting student to the interrelationships between auditing and corporate governance with an emphasis on the societal role of auditing, internal control and professional ethics. Enrollment limited to ACIS majors or with permission of instructor. Pre: (3504 or 3515). (3H,3C)

#### 3504: ACCOUNTING SYSTEMS AND CONTROLS

Examines system design concepts and methods including an understanding of basic control structures. Covers specific accounting cycles and computerized transaction processing systems. Analyzes controls for manual and computerized systems including database systems. Pre: 2115. Co: 2504, 2116. (3H,3C)

#### 3515-3516: INFORMATION SYSTEMS DEVELOPMENT

Study of the strategies and techniques for dealing with the inherent complexity in the development of information systems. Includes coverage of business systems planning; fact-finding and requirements analysis techniques; information systems modeling; logical and physical design; input and output design; user interface design; software construction and testing; software configuration management; and software quality assurance. Upper division clearance required. Pre: 1504, (CS 1054 or CS 1114 or CS 1124 or CS 1705) for 3515; 3515 for 3516. (3H,3C)

#### 3564: MANAGEMENT INFORMATION SYSTEMS

An overview of management information systems. Topics include the organizational foundations of information systems; the technical foundations of information systems; the approaches to building information systems; and the management of contemporary information systems. Pre: 1504, 2115, 2116. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4024: INFORMATION SYSTEMS AUDIT AND CONTROL

An introduction to the fundamentals of information systems auditing. Emphasis on information systems controls, types of information systems audits, and concepts and techniques used in information systems audits. Exposure to risk assessment and professional standards in the field of information systems auditing. Pre: 3504 or 3515. (3H,3C)

#### 4114: ADVANCED FINANCIAL ACCOUNTING

A continuation of a detailed analysis of the concepts of external financial reporting begun in 3115 and 3116. Includes transaction analysis and preparation of financial statements. Pre: 3116, ECON 2006. (3H,3C)

#### 4124: GOVERNMENTAL AND NONPROFIT ACCOUNTING

An analysis of the environment and characteristics of government and nonprofit organizations, and an in-depth study of basic concepts and standards of financial reporting for such entities. Pre: 3115. (3H,3C)

#### 4194: ANALYSIS OF FINANCIAL STATEMENTS

Provide theoretical background and tools necessary to analyze financial statements from the perspective of making valuation and investment decisions. The focus of the course is on the use of accounting information in making these decisions. Pre: 3116 or FIN 3134. (3H,3C)

#### 4214: COST PLANNING AND CONTROL

The purpose of this course is to help the student develop an understanding of the role of accounting in the management process, an understanding of cost accounting systems, an understanding of cost behavior, an understanding of alternative accounting systems, and the usefulness of costs involved in non-routine decision-making. Pre: 2116, 2504, BIT 2406. (3H,3C)

#### 4314: PRINCIPLES OF TAXATION

Survey of basic concepts of federal income taxation that are common to all types of taxpayers (i.e. individuals, corporations, and flow-through entities). Topics to be covered include tax policy objectives, tax accounting methods that affect the timing of income and expense recognition, concepts of gross income and trade or business expenses, income character, and tax issues associated with various property transactions. Pre: 3314. (3H,3C)

#### 4344: TAX FOR FINANCIAL PLANNERS

Overviews income tax concepts relevant to financial planning for individuals who are investors, employees, and business owners. Topics include income tax fundamentals for individuals, taxation of the sale of property, taxation of business entities, taxation of trusts, and overview of the federal transfer tax on estates and gifts. Duplicates some material in ACIS 4314. Course credit will not be awarded for both ACIS 4314 and ACIS 4344. Pre: FIN 3104. (3H,3C)

#### 4414: FINANCIAL STATEMENT AUDITING

Study of external financial statement auditing, professional code of conduct, audit evidence considerations, internal control, fraud, and transaction cycles, and audit reporting. II, IV Pre: 3414, 3115. (3H,3C)

#### 4444: FORENSIC ACCOUNTING

This course provides students experience in forensic accounting, commonly used computer forensic software, forensic techniques, litigation support, fraud risk management, fraud investigation, and the related audit tools. Pre: 3414. (3H,3C)

#### 4504: ACCOUNTING APPLICATION DEVELOPMENT

Utilizes current software tools to design and develop segments of accounting systems using database management techniques. Provides an understanding of relational databases, query languages, and web-based business processing. Includes exposure to latest relevant technology and software. Provides development knowledge of controls in accounting information systems. Pre: 3504. (3H,3C)

#### 4514: DATABASE MANAGEMENT SYSTEMS

Introduction to database management systems and their use in business. Topics covered include data modeling, normalization, SQL, transaction management and concurrency control, security issues, physical data organization, query optimization, hierarchical queries, distributed database management systems, object-oriented databases, client/server databases, multidimensional databases, data mining, data warehousing, and database administration. Pre: 3515. (3H,3C)

#### 4524: APPLIED SOFTWARE DEVELOPMENT PROJECT

Application of computer programming and system development concepts, principles, and practices to a comprehensive system development project. A team approach is used to analyze, design, and document realistic methods, project 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. Pre: 3515 or 4514 or 4515. (3H,3C)

#### 4534: ACCOUNTING INFORMATION SYSTEMS ARCHITECTURE

Provides accounting and information systems audit students with basic computer hardware, operating systems software, and networking knowledge. Topics covered include data representation, processor, data storage, and input/output technology, computer networks, operating systems, storage management, and distributed applications. Pre: 3504 or 3515 or BIT 3424. (3H,3C)

#### 4554 (BIT 4554): NETWORKS AND TELECOMMUNICATIONS IN BUSINESS

This course provides an in-depth introduction to computer networks and data communications in business. Topics include mechanisms for reliable data transfer, local and wide area network topologies and technologies, and a comprehensive treatment of internetworking. The benefits, costs, and security issues related to using computer networks are discussed, along with network design issues, and methodologies for network applications. One semester of college-level programming experience required. Pre: 3504 or 3515 or BIT 3424. (3H,3C)

#### 4564 (BIT 4564): OBJECT-ORIENTED SYSTEMS DEVELOPMENT FOR BUSINESS

The course first develops the foundations and principles of object-oriented programming, including encapsulation, inheritance, polymorphism, and abstraction. These concepts are acquired via comprehensive hands-on experience with a current OOP language (such as Java). The second portion of the course applies concepts learned to a business-oriented application, such as a web-based, e-commerce scenario. Pre: CS 1054, (ACIS 3515 or BIT 3444). (3H,3C)

#### 4684: INFORMATION SYSTEMS SECURITY AND ASSURANCE

An examination of the concepts, technologies, and applications of security and assurance in information systems. Topics include the security threats against information systems; tools used by intruders; computing platforms and security; encryption; securing the transaction and the server; audit tools to detect intrusions; responses to attacks; legal, ethical and international issues; and the future of information systems security and assurance. Pre: (4554 or BIT 4554) or ACIS 4534. (3H,3C)

#### 4954: STUDY ABROAD

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Apparel, Housing, and Resource Management

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### Overview

[Fashion Merchandising and Design Major](#)

[Consumer Studies Major](#)

[Residential Environments and Design Major](#)

[Property Management Major](#)

[Family and Consumer Sciences Major](#)

[Undergraduate Course Descriptions \(AHRM\)](#)

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**Head:** Julia O. Beamish

**Residential Property Management Advisory Board Professor:** R.C. Goss

**International Textile and Apparel Association Fellow:** M.J.T. Norton

**Professors:** J.O. Beamish, L.R. Gaskill, R.C. Goss, D.H. Kincade, M.J.T. Norton, and K. Parrott

**Associate Professors:** H.I. Chen-Yu, P.J. Fisher, and I.E. Leech

**Assistant Professors:** E.Z. Hopkins, E. Hwang, J. E. Lee, D.C. Read, and O. Solis

**Instructor:** M.G. Carneal

Web: [www.ahrm.vt.edu](http://www.ahrm.vt.edu)

## Overview

The mission of the Department of Apparel, Housing, and Resource Management is to improve quality of life for individuals, families, and the broader community by creating and extending knowledge in apparel, housing, and resource management. We apply business, consumer, and design perspectives to teaching and learning, research, and outreach.

The AHRM Department includes five majors Consumer Studies, Fashion Merchandising and Design, Property Management, Residential Environments and Design, and Family and Consumer Sciences.



## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

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Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Fashion Merchandising and Design Major

### Career Advisor: Doris Kincade

Apparel fashion is an exciting and competitive field where designers, product developers, manufacturers and retailers create and merchandise products and services for target customers. The Fashion Merchandising and Design major prepares students for diverse career opportunities available to graduates of the program. Students may find employment with apparel or textile manufacturers or with a wide variety of retailers and fashion media, including magazines and social media websites. Products in apparel fashion range from fast fashion and haute couture to special-use apparel for athletes and extreme sports to accessories and shoes. Graduates from the FMD major may be employed in the areas of product development and/or merchandising. Positions in merchandising include: assistant buyer, buyer, fashion journalist, internet merchant, merchandise manager, showroom manager, store manager, and visual merchandiser. Positions in design and product development include: creative designer, technical designer, private label manager, sourcing analyst, and production manager.

The FMD curriculum is structured to build students' knowledge and skills in the design, development, production, marketing, sale, and use of apparel and other textile products. Individuals employed in today's fashion world need to understand both product design and development and merchandising management. In addition, students learn details about the business and economics of the textile and apparel industry and the cultural and historic aspects of apparel fashion. Supporting courses in accounting or statistics, management, and marketing enhance career preparation.

Many courses in the FMD major promote hands-on learning so that students gain industry type experiences in product development, computer-aided design, textile and apparel evaluation, merchandise planning, promotion, and consumer patronage behavior. Through coursework, internships, study tours, student organizations, and interaction with industry experts, students become prepared to enter the dynamic apparel fashion field.

## Consumer Studies Major

### Career Advisor: I. Leech

The Consumer Studies major prepares students to enter a variety of careers in the public and private sectors. Central to these careers is the ability to analyze issues and problems from the perspectives of consumers, business, and government. Students learn to reasonably advocate consumer interests and to help consumers improve their well-being. They develop fundamental skills that are used to resolve problems faced by consumers in the market place and the work place.

Graduates enter careers related to consumer affairs, marketing and sales, business management, and human resources. Required courses build a thorough understanding of households in the dual roles of

producers and consumers that function within an international economic marketplace affected by government policy and regulation. Students study current events to track changing conditions and public policy. Additional courses develop skills for effectively processing and conveying information. A choice of controlled electives enables a student to tailor study to consumer products and promotion or consumer financial services, and counseling.

Consumer Studies students are provided a variety of learning experiences on- and off-campus. Through involvement with student professional associations, as well as relevant state and national organizations, students can develop leadership and organizational skills and network with active professionals. There are opportunities to relate classroom learning to the "real world" with projects and visits with industry, legislators, and regulators. An individualized study experience, typically an internship related to personal career interests, is required.

## Residential Environments and Design Major

**Career Advisor: K. Parrott**

The Residential Environments and Design (RED) major focuses on the planning, design, and marketing of residential environments. Required courses emphasize design, human, social, and business factors, including current issues and practices, which influence the environment of housing. The diversity of the population with differing needs, the range of available products, the growth of regulation, the increased concern for health and safety, and the rapid changes in technology are among the factors that lead to a very complex marketplace in the residential industry.

There are many career opportunities for graduates of the RED major, which provide employment as well as business opportunities. Employment opportunities include certified kitchen and bath designers, manufacturing and sales of residential products, residential construction, home furnishings, appliances, and related industries. The future looks bright for those students who choose careers in the residential design industry. A number of trend and demographic indicators suggest that people will continue to spend money on their homes and need products and services from experts. There will be a strong, on-going need in the residential industry for well-educated professionals with specialized knowledge in design and the ability to think and solve complex problems.

The RED major's program in kitchen and bath design is accredited by the National Kitchen and Bath Association, and interested students can prepare to sit for the first level design certification examination. Students in the major are mentored by industry members of the Residential Environments and Design Industry Board. Classroom learning is expanded through field trips, guest speakers, community clients, internships, competitions, and other special projects.

## Property Management Major

**Career Advisor: R. C. Goss**

Property management offers a fast-growing career encompassing positions in luxury and affordable apartment developments, senior living communities, mixed-use, and office and retail properties. Hundreds of management positions are available each year, and graduates of Virginia Tech's program are in great demand because they are equipped with skills that address the complexities of managing multimillion-dollar investments. Employment is available in various aspects of the industry including management, operations, marketing, human resources, training, development, and acquisitions.

The property management major offers a wide-ranging program of study that includes specific courses in property management, as well as supporting courses in housing, business, and real estate. All students complete at least one internship that is typically a paid internship with housing provided. The internships give students an opportunity to gain real-world experience, make valuable career contacts, and explore different aspects of property management. Property management's very active advisory board visits campus twice yearly, and many also attend the property management career fair held on campus each March. Board members act as mentors and provide financial support for field trips, professional

development, and scholarships. Property management seniors take the National Apartment Association's Certified Apartment Manager exam. Graduating with this credential places new employees a year or more ahead of other entry-level peers.

## Family and Consumer Sciences Major

### Career Advisor: J. Beamish

Family and Consumer Sciences (FCS) is a comprehensive study of the relationship between individuals, families, and communities, and the environment in which they live. The FCS major prepares graduates to help people make informed decisions about their well-being, their relationships, and their resources in order to achieve an optimal quality of life. FCS combines courses in consumer studies, family finance, housing, residential equipment, clothing, human development, nutrition, and health. This multidisciplinary program also encourages students to focus in depth on these topics, through the selection of a broad list of controlled electives, as well as an industry internship.

The FCS curriculum incorporates the content courses needed to achieve licensing to teach Family and Consumer Sciences at the secondary level in Virginia. To become licensed to teach through Virginia Tech, graduates of the FCS program should pursue a Master of Sciences in Education degree with a major in Career and Technical Education. Students who study Family and Consumer Sciences could also choose to work in other community educational settings, such as the Cooperative Extension Service, human resource departments, or nonprofits. They could also work with industries to provide programs in family and individual well-being or in media that provide information about families and consumer goods to the public.

## Undergraduate Course Descriptions (AHRM)

### 1104: INTRODUCTION TO AHRM AND STUDENT RESOURCES

Introduction to the Department of Apparel, Housing, and Resource Management (AHRM), majors, and faculty expertise. Introduces students to co-curricular learning opportunities including the concept of undergraduate research. Exploration of numerous programs and services to enhance awareness of opportunities and support systems available for student development. (3H,3C)

### 1204: CLOTHING AND PEOPLE

A personal and societal approach to the study of clothing and its importance in people's lives. Social, psychological, and economic forces that affect clothing behavior of individuals and groups. Fundamentals of clothing and textiles importance to consumers. (3H,3C)

### 1214: FASHION PRESENTATION TECHNIQUES

Basic principles and methods for executing fashion and specification illustrations and technical flats. Practice and skill development using a variety of manual and computer tools. Emphasis on the correct use of industry terminology. (2H,2L,3C)

### 1624: RESIDENTIAL DRAFTING LAB

Principles of visual presentation of housing designs. Introduction to hand and computer drafting. (2L,1C)

### 2034: HISTORY OF COSTUME

A study of costume worn by people in historical and contemporary periods. Coverage of the evolution and development of Western costume. Use of fashion, clothing, and design terminology. Influence of historic costume on contemporary fashion and design. (3H,3C)

### 2204: INTRODUCTION TO TEXTILES

Structure, properties and basic production of textiles and textile components: natural and manufactured fibers; yarns; woven, knit, nonwoven fabrics; mechanical and chemical finishes; colorants and coloration methods. Influence on performance of apparel and interior textile products. Sophomore standing and one semester (lecture) of university core requirement in Scientific Reasoning and Discovery is required. Co: 2214. (3H,3C)

#### 2214: APPAREL TEXTILES LABORATORY

Identification and characterization of textiles and textile components including: fabrics, finishes and coloration. Influence of these structural parameters on performance of apparel textiles. Co: 2204. (3L,1C)

#### 2234: HOUSING TEXTILES

Identification of structural elements of housing textiles: natural and manufactured fibers; yarns; woven and other fabrics; finishes; and colorants and their applications. Influence of textile structure on serviceability properties of housing textiles. Exploration of sustainable textiles and related labeling as well as housing textile products and safety and health. Selection of textiles for application such as upholstered furniture, window treatment, and carpeting and rugs. Pre: sophomore standing. (3H,3C)

#### 2264: APPAREL PRODUCT DEVELOPMENT

Study of the pre-production stage of product development in the apparel industry, including planning a line based on market, consumer, and product research, forecasting trends in color, style and materials, developing and selecting designs and styles, and wholesale marketing of a line to retail buyers. Also includes the use of diverse inspiration sources for creating a design, application of computer-aided design to design and style development, and identification of career opportunities and qualifications for professional positions in the industry. Pre-requisite: Sophomore Standing required. Pre: 1214. (2H,2L,3C)

#### 2304: FAMILY FINANCIAL MANAGEMENT

Overview of family financial management. Analysis of financial situations of individuals and families; assessment of needs for cash and credit management, insurance, tax savings, and investments; introduction to components of a comprehensive family financial plan. (3H,3C)

#### 2404: CONSUMER RIGHTS

Changing role of consumers in American society from the perspective of the consumer interest. Consumers' legal and moral rights, responsibilities and means for successfully obtaining redress of grievances. Processes of government regulation and policy making that affect consumers. Current consumer problems and issues in such areas as ripoffs and frauds, food, health care, product safety, banking, credit, housing, insurance and investments. (3H,3C)

#### 2604: HOUSE PLANNING

Principles of space planning and housing design in relation to individual and family activities, needs, and preferences. Introduction to house construction. Reading visual presentations of housing designs. (2H,2C)

#### 2614: INTRODUCTION TO RESIDENTIAL TECHNOLOGIES

Principles underlying the selection, use and care of equipment and lighting in the home and the infrastructure that supports home technologies. (2H,2C)

#### 2634: RESIDENTIAL TECHNOLOGIES LABORATORY

Basic principles of home technologies and their applications in the home. Co: 2614. (2L,1C)

#### 2644: HOUSING AND THE CONSUMER

Overview of housing as it relates to consumer needs, values, lifestyles, norms and constraints. Includes structural and tenure alternatives, financial and legal considerations, house design, neighborhood choices, the home buying process, and future directions in housing. Government aspects focus on the history of federal involvement in housing, major housing programs, role of state and local government, and current housing issues and policies. (3H,3C)

#### 2654: HOUSING ENVIRONMENTS

Basic design elements and principles in housing products and spaces. Qualities of spatial elements and housing products. The design process as used to explore the selection and application of these elements and products for specific user needs in housing environments. Pre: 1624. (2H,2L,3C)

#### 2664: INTRODUCTION TO RESIDENTIAL PROPERTY MANAGEMENT

The history of property management, roles and responsibilities of managers, developing effective marketing and maintenance strategies, fair housing, and landlord-tenant law. (3H,3C)

#### 2674: MULTIFAMILY PROPERTY MANAGEMENT AND OPERATIONS

Multifamily rental real estate including detailed examination of operational and financial aspects of multifamily property management. (3H,3C)

#### 2964: FIELD STUDY

Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3104: FASHION RETAILING CONCEPTS

Detailed investigation and analysis of the fundamentals of fashion merchandising concepts emphasizing problem solving at the retail level. Prerequisite: one semester of Curriculum for Liberal Education Area 5 - Quantitative and Symbolic Reasoning required. Junior Standing. Pre: 1204. (3H,3C)

#### 3204: INTRODUCTION TO TEXTILE EVALUATION

Analysis of the performance properties of fabrics. Importance of evaluation to product development, quality control, and specification of care requirements. Pre: 2204, 2214. (2H,3L,3C)

#### 3224: APPAREL PRODUCTION

Application of concepts and principles of basic and intermediate-level apparel patternmaking and construction from the apparel industry perspective to the creation of prototypes, product specifications, and finished products. Students will gain conceptual understanding of simple to complex apparel construction techniques, learn the stitch and seam types and their applications, and develop skill in using a variety of manual and computer tools and equipment for apparel patternmaking and construction. Pre-requisite: Sophomore standing. Pre: 1204. (3H,3L,3C)

#### 3234: FIT, PATTERNMAKING, AND DRAPING

Study of apparel product development from the apparel industry point of view using intermediate and advanced techniques and skills. Focus on conceptual understanding and application of garment fit, pattern and product alteration, pattern grading, and marker making principles and of flat-pattern and manikin-drape techniques used in apparel engineering and product development, along with development, along with development of skill in using a variety of related manual and computer tools. Pre-requisite: Junior Standing required. Pre: 3224. (3H,3C)

#### 3244: SMALL BUSINESS APPAREL RETAIL DEVELOPMENT

Comprehensive study of small business concepts as applied to the textile and apparel retail industry. Analysis of the entrepreneurial mindset and strategies for business entry with emphasis on small business development, including concept and opportunity identification, merchandising and management, operations and control, advertising and promotion, and financial planning for a textile and/or apparel retail business. Pre: 2264, 3104. (3H,3C)

#### 3254: GLOBAL APPAREL PRODUCTION AND TRADE

Study of evolution, basic elements, patterns, and implications in developed and developing countries of contemporary global apparel production and trade. Course topics also include key roles of U.S. firms and government agencies in global apparel production and trade, the types and roles of firms that participate in such production and trade, as well as international trade policies and other factors that influence global apparel production and trade. Pre-requisite: Junior Standing required. (3H,3C)

#### 3404: CONSUMER EDUCATION STRATEGIES

Analysis of the role of effective consumer education strategies in consumer decision-making. Planning, developing, testing, and evaluating consumer education programs using a variety of strategies, including social marketing, for selected community partners and operating the Consumer Education Laboratory.

Pre: 2304, 2404. (2H,2L,3C)

#### 3464 (APS 3464) (GEOG 3464) (HD 3464) (HUM 3464) (SOC 3464) (UAP 3464): APPALACHIAN COMMUNITIES

The concept of community in Appalachia using an interdisciplinary approach and experiential learning. Interrelationships among geographically, culturally, and socially constituted communities, public policy, and human development. Pre: Junior standing. (3H,3C)

#### 3504: RESOURCE MANAGEMENT FOR INDIVIDUALS & FAMILIES

Introduction to resource management concepts and theories with application to personal and family life goals. Discussion of values, goals, decision making, planning, and communication in relation to the management process. Application of the management process to the use of resources, time, finances, stress, and the environment. Pre: 2304. (3H,3C)

#### 3624: HOUSE PLANNING II

Principles of space planning, including activity analysis and user needs, as applied to residential settings. Graphic design solutions for specific areas of the home, including social, private, kitchen, and outdoor areas. Pre: 2604, 2634, 2654. (6L,3C)

#### 3634: DEVELOPING AND MANAGING AFFORDABLE AND SPECIALIZED HOUSING

Development and operation management of affordable multifamily, military, and student housing, as well as community associations and mixed-use housing developments. Consideration of consumer lifestyles, financial circumstances, and sustainability issues for each housing option. Pre: 2674. (3H,3C)

#### 3644: AMERICAN HOUSING

Overview of the role of housing in family life and society throughout the history of the United States. Exploration of the impact of technology, resources, and societal values on the design and style of housing and products used in the home. (3H,3C)

#### 3674: ADVANCED RESIDENTIAL TECHNOLOGIES

Residential technologies, such as lighting, communications, and security systems, their impact on home activities, and how they can be successfully integrated into the house structure and design. Pre: 2614. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4024: PORTFOLIO

The development and production of a professional apparel portfolio in both paper and ePortfolio format. Pre-requisite: Senior Standing required; 3234 or permission of the instructor. Pre: 3234. (3H,3C)

#### 4124: CLOTHING BEHAVIOR PATTERNS

Study of clothing behavior of individuals in relationship to their needs, values, attitudes, interests, and self-concepts. Overview of principles and theories related to individuals' emotional, mental, and physical activities when obtaining, using, maintaining, and disposing of apparel products so as to satisfy their needs and desires. Application of principles and theories related to clothing behavior to the analysis of consumer and the development of effective merchandising strategies. Pre: 3104, (PSYC 2004 or PSYC 1004 or SOC 1004). (3H,3C)

#### 4214: ECONOMICS OF THE TEXTILE AND APPAREL INDUSTRY

Study of the various segments of the textile and apparel industry. Analysis of the market structure and functioning of each segment and of factors currently affecting the industry. Pre: 2204, (ECON 2006 or ECON 2006H) or (AAEC 1005, AAEC 1006). (3H,3C)

#### 4224: FASHION ANALYSIS AND COMMUNICATION

Analysis of factors influencing fashion change and acceptance. Application of effective promotional activities to trade, national, and retail levels of fashion merchandising. Senior standing required. Pre: 2264, MKTG 3104. (3H,3C)

#### 4234: APPAREL QUALITY EVALUATION

Study of quality of ready-to-wear apparel and factors that influence variations in the aesthetic and functional performance of the end product, including consumer perceptions and expectations, manufacturing processes and trends, and the physical components of the end product. Pre: 3224, 3204. (3H,3C)

#### 4244: NEW YORK FASHION STUDY TOUR

Integrative study of methods of operating at all levels within the fashion industry. Special emphasis on design, merchandising, and promotional activities. Seminars on campus and at pre-arranged appointments during a five-day stay in New York. AHRM major; Junior standing. Twelve hours of AHRM courses required. (3H,3C)

#### 4264: MERCHANDISING STRATEGIES

A senior capstone course providing students with experience in synthesizing and using course content learned throughout their apparel program. Includes projects in forecasting, product development and promotions as used in the apparel industry in preparing and positioning products in the market. Pre: 3104, 4234, 4224. (3H,3C)

#### 4274: INTERNATIONAL SOURCING OF APPAREL

Study of international sourcing of apparel products through a step-by-step simulation of the sourcing process to help students understand the procedures and documents needed to source apparel abroad. Also includes discussion of career opportunities related to sourcing apparel products abroad. Pre: 4234. (3H,3C)

#### 4314: DEBTOR-CREDITOR RELATIONSHIPS

Examination of legal and operational aspects of debtor-creditor relationship from the perspective of businesses and debtors. Overview of the types of credit, access to credit, factors contributing to debt problems, and alternatives available for resolution. Focus on collection processes of federal and state bankruptcy laws and regulations. (3H,3C)

#### 4324: FINANCIAL COUNSELING

Examination of debt and budgeting problems affecting families. Utilizes a problem-solving approach. Includes financial counseling strategies for coping with financial crises and becoming proactive in family financial management. (3H,3C)

#### 4404: CONSUMER PROTECTION

Analysis of the effectiveness of consumer protection efforts. Examination of government laws, regulations, and agencies at the federal, state, and local levels, as well as the effectiveness of both business and private consumer protection efforts. (3H,3C)

#### 4414: PROFESSIONALISM IN CONSUMER AFFAIRS

Roles, functions and responsibilities of consumer affairs professionals employed in business, government, and non-profit public/consumer interest organizations. Professional advocacy within employing organizations, managing consumer complaint handling systems and major consumer and career issues are analyzed. (3H,3C)

#### 4604: HOUSING: ENERGY AND THE ENVIRONMENT

A study of the development and management of sustainable housing, emphasizing energy and environmental resource efficiency. (3H,3C)

#### 4604H: HOUSING: ENERGY & ENVIRONMENT

Honors section (3H,3C)

#### 4624: ADVANCED KITCHEN AND BATH DESIGN

Planning, design, and evaluation of residential kitchens and bathrooms, in relation to the total house plan. Emphasis on planning principles and technical requirements with attention to functional use of the spaces to meet the needs of people. Pre: 3624, 3674. (6L,3C)

#### 4644: ADVANCED PROPERTY AND ASSET MANAGEMENT

Examination of the competencies necessary to maximize the value of real estate assets through effective operations and financial management practices. Includes detailed examination of income maximization, financial reporting, and ownership objectives of real estate investors. Pre: 2674, 4964. (3H,3C)

#### 4654: ADVANCED TOPICS IN HOUSE PLANNING

Advanced topics in house planning, particularly kitchen and bath design, with emphasis on independent work of portfolio quality. May be repeated for a maximum of 6 credits. Pre: 4624. (6L,3C)

#### 4664: UNIVERSAL DESIGN

Evaluation and design of commercial and residential environments with consideration for accessibility, adaptation, safety, and support of the user(s). (2H,2C)

#### 4674: MANAGING AND MARKETING HOUSING FOR LATER LIFE

Managing and marketing housing for later life, including active adult communities and assisted living facilities. Pre: Junior Standing (2H,2C)

#### 4684: MANAGING AND LEASING COMMERCIAL PROPERTIES

Examination of commercial property management considerations associated with office building, medical offices, industrial property, and shopping center space relative to leasing and negotiation, maintenance, marketing practices, and legal and fiduciary responsibilities of the property manager. Pre: Junior Standing (3H,3C)

#### 4694: CONTEMPORARY ISSUES IN PROPERTY MANAGEMENT

Issues affecting property management, including ethics, professional management decisions, legislative issues, and current management practices. The course culminates in the analysis of an apartment community and development of a management plan. Pre: 4964 and senior standing in the Residential Property Management option or 5964 and graduate standing. Pre: 4964 or 5964 or 4644. (3H,3C)

#### 4764: UNIVERSAL DESIGN LAB

Design of residential spaces that meet the needs of a range of users, including older adults and people with disabilities. Principles of universal design are applied to the spatial requirements and product selection for the home. Pre: 3624. Co: 4664. (2L,1C)

#### 4914: RESIDENTIAL PROPERTY MANAGEMENT STUDY TOUR

Study tour that examines trends in the multifamily housing industry focusing on marketing, management, design, and customer service. Variable credit 2 credits maximum. Pass/Fail only. Variable credit course. Co: 4694.

#### 4924: HOUSING STUDY TOUR

A study tour designed to examine the housing industry and trends in design, technology, products and processes. Junior standing required. Variable credit. May be repeated for a maximum of 6 credits Pass/Fail only. Variable credit course.

#### 4964: FIELD STUDY

Variable credit course. X-grade allowed.

#### 4964H: FIELD STUDY

Variable credit course. X-grade allowed.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4984H: SPECIAL STUDY



Honors Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

### Agricultural, Leadership, and Community Education

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#### Overview

[Agricultural Sciences Major \(AGSC\)](#)

[Leadership and Social Change Minor \(LDRS\)](#)

[Satisfactory Progress](#)

[Undergraduate Course Descriptions \(ALCE\)](#)

[Undergraduate Course Descriptions \(LDRS\)](#)

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**Head:** Rick Rudd

**Professors:** L. V. Crowder and R. D. Rudd

**Associate Professor:** E. K. Kaufman, K.L. Niewolny, and D. M. Westfall-Rudd

**Assistant Professors:** J. C. Anderson, T. G. Archibald, C. R. Friedel, H. Scherer, and M. K. Spindler

**Professor of Practice:** K. R. Gehrt

**Lecturer:** M.M. Seibel and K. A. Vines

**Emeritus Faculty:** S. R. Burke, W. G. Camp, J. P. Clouse, J. R. Crunkilton, J. H. Hillison, M. B. McMillion, and J. D. Oliver

**Undergraduate Program Director:** C. R. Friedel (231-8177; cfriedel@vt.edu)

Web: [www.alce.vt.edu](http://www.alce.vt.edu)

### Overview

The Department of Agricultural, Leadership, and Community Education at Virginia Tech is committed to preparing students for success in professions that apply agricultural content to social settings. We offer a major in Agricultural Sciences and a minor in Leadership and Social Change. Our Agricultural Sciences students will experience an interdisciplinary program of study designed to address the growing needs of today's evolving agricultural and food systems. The Leadership and Social Change minor is available to students of all majors across the university. The minor embraces a commitment to diversity and an

agenda for social change that crosses all disciplines of study.

## Agricultural Sciences Major (AGSC)

The Bachelor of Science in Agricultural Sciences is intended for individuals who want to collaborate to address the growing needs of today's evolving agricultural and food systems.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

For additional information about the Agricultural Sciences degree, contact the department's advising office, 231-8177, or Dr. Curtis Friedel, [cfriedel@vt.edu](mailto:cfriedel@vt.edu).

## Leadership and Social Change Minor (ILRM)

The Leadership and Social Change minor is available to students of all majors across the university. The minor embraces a commitment to diversity and an agenda for social change that crosses all disciplines of study. Internships in businesses and organizations are encouraged as an extremely valuable way for students to gain work-related leadership skills.

The Leadership and Social Change minor requirements may be found by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

For additional information about the minor, contact 231-8177, or Curtis Friedel, [cfriedel@vt.edu](mailto:cfriedel@vt.edu).

## Satisfactory Progress

By the end of the academic year in which the student enrolled in the Agricultural Sciences major has attempted 72 hours (including transfer, advanced placement, advanced standing and credit by examination), "satisfactory progress" will consist of:

- GPA of at least 2.0
- at least 24 credits that apply to the Curriculum for Liberal Education, and
- at least 9 semester credits of departmental requirements.

## Undergraduate Course Descriptions (ALCE)

### 1004: STRENGTHS DEVELOPMENT FOR CAREERS IN AGRICULTURAL SCIENCES

Exploration of self-development and career planning related to personal talents and strengths. Special attention will be devoted to pathways for learning within the Agricultural Sciences degree program. This course is intended for students in their first year of enrollment at Virginia Tech. (1H,1C)

### 2974: INDEPENDENT STUDY

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3004: EDUCATIONAL PROGRAMS IN AGRICULTURAL AND LIFE SCIENCES**

Offers a foundation for student engagement and exploration of educational programs within agricultural and life sciences. Formal and non-formal learning contexts in local community programs. Opportunities include fieldwork assignments. (3H,3C)

**3014: LEADERSHIP EFFECTIVENESS FOR PROFESSIONALS IN AGRICULTURAL ORGANIZATION**

Designed to assist students in developing a knowledge and understanding of leadership theory and basic skills required to perform effectively in leadership positions within agricultural community situations. (3H,3C)

**3074: MATERIALS AND PROCEDURES OF AGRICULTURAL CONSTRUCTION**

Introduction to materials selection and construction procedures for carpentry, concrete, and masonry construction. Understanding and skills applicable to construction of agricultural buildings. Junior standing or consent of instructor required. (1H,6L,3C)

**3084: AGRICULTURAL METAL FABRICATION**

Introduction to metal working tools, equipment, and processes. Fundamentals of hot and cold metal working, plumbing, and welding applications, including inert gas welding processes. Junior standing or consent of instructor is required. (1H,6L,3C)

**3624: COMMUNICATING AGRICULTURE IN WRITING**

Development of communication skills necessary to deal with the general public and audiences in the food, agriculture, and natural resources fields. Emphasis on writing and on creation of a portfolio including multiple types of written communication. (3H,3C)

**3634: COMMUNICATING AGRICULTURE & LIFE SCIENCES IN SPEAKING**

Development of strategies and techniques for effective oral communication in the professions related to food, agriculture, and natural resources. Emphasis on oral, visual, and interpersonal communication, as well as group leadership and meeting management. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course.

**4004: TEACHING ADULTS IN AGRICULTURE**

Organizing classes, developing programs of instruction and teaching techniques applicable to out-of-school groups in Agriculture. (2H,2C)

**4014: INTRO TO COOPERATIVE EDUCATION**

An overview of the Cooperative Extension Service as it applies to non-formal education for citizens and communities. Major areas discussed include history, organization, functional areas, responsibilities of local agents, employment in extension, and educational program planning. (3H,3C)

**4024: MANAGING AGRICULTURAL SUPERVISED OCCUPATIONAL EXPERIENCE PROJECT**

Major emphasis will be given to the agricultural teacher's responsibility for supervision of the Supervised Occupational Experience Program (SOEP). The course will emphasize the ownership project, the cooperative placement project, maintaining record books, and supervising the SOEP. (2H,2C)

**4034: METHODS OF PLANNING EDUCATION PROGRAMS FOR AGRICULTURE**

Course examines the procedures involved in the development of courses, curriculum, and instructional materials for education programs in agriculture. Variable credit course. Pre: 3004 or 3004 or AEE 3004 or AEE 3004.

**4044: AGRICULTURAL SCIENCES SEMINAR**

A senior capstone course addressing issues of importance for majors in Agricultural Sciences. The course will emphasize a synthesis of research results from collected data and information on contemporary problems in agriculture and related fields and a sharing of the results. It will emphasize the

development of skills in critical analysis. Senior Standing required. (3H,3C)

**4054: INTERNSHIP IN COOP EXTENSION**

Off-campus participation experience for those preparing to become extension agents in the Cooperative Extension Service. Variable Credit; 6-16 credits. Variable credit course.

**4064: AG MECHANICAL LAB MANAGEMENT**

Plan, organize, and manage secondary school mechanics laboratories. Management of the instructional program, facility, equipment, inventory, safety, liability, personnel, material control, and student customer work. (2H,3L,3C)

**4234: CURRICULUM FOR CAREER AND OCCUPATIONAL EDUCATION**

Provides current and prospective career and occupational education teachers with research bases, resources, and available curricula for teaching content in the respective disciplines. Develops the ability to plan, manage, develop, and evaluate curricula. The prerequisite EDCT 2604 will be waived for Agricultural Education students. Pre: EDCT 2604. (3H,3C)

**4244: TEACHING AND TRAINING METHODS IN AGRICULTURAL AND LIFE SCIENCES**

Survey of strategies for design, implementation, and evaluation of instruction and training practices in agricultural life sciences. Applications of principles in formal and non-formal educational settings, including schools, extension, and industry. Pre: 4234 or AEE 4234. (3H,3C)

**4254: ADULT VOCATIONAL & TECHNICAL ED**

Theory, practices, and procedures involved in planning, developing, implementing, managing, and evaluating adult education programs in Vocational and Technical Education. Completion of, or concurrent enrollment in, courses in teaching methods and curriculum required. (3H,3C)

**4304: COMMUNITY EDUCATION AND DEVELOPMENT**

Comprehensive examination of community education and development. Community/sustainable community development, strategies for mobilizing social change in/with communities. Explore participatory, popular, and community-based education from rural and urban settings. Globalization, sustainability, and social movement discourse with emphasis on agricultural, health, and food system examples. Pre: Junior standing. (3H,3C)

**4744: METHODS, MATERIALS AND PRACTICES IN INSTRUCTION**

Planning, using, evaluating classroom procedures; selection and organization of subject content and materials in vocational and technical education. Maximum credit: 6 Consent required. Variable credit course. Co: EDCT 4754.

**4754: INTERNSHIP IN EDUCATION**

Planned program of clinical practice in education under the direction and supervision of a university supervisor and a selected practitioner. Recommendation of program area and successful completion of Professional Studies required. Variable credit course.

**4884: YOUTH PROGRAM MANAGEMENT**

Organizational design of educational youth programs such as 4-H and FFA, including administrative planning, human resource development, recruitment, marketing, and budgeting. (3H,3C)

**4964: FIELD STUDY/PRACTICUM**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDEGRADUATE RESEARCH**

Variable credit course.

## Undergraduate Course Descriptions (LDRS)

### 1015-1016: EXPLORING CITIZEN LEADERSHIP

This two-semester interdisciplinary course offers an introduction to citizen leadership. 1015 explores traditional and contemporary leadership theory and competencies by comparing cultural contexts of leadership. 1016 introduces leadership praxis (action and reflection) as a method of research and service designed to continually refine leadership theory, competencies, and values. (3H,3C)

### 2014: PRINCIPLES OF PEER LEADERSHIP

Examine theories and basic principles associated with being a positive influence on fellow students and develop leadership skills utilized to motivate peers in teamwork-based scenarios. Concurrent experience required serving as a peer leader. (3H,3C)

### 2964: FIELD STUDY

May be repeated for a maximum of 6 credits. Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3104: THE DYNAMICS OF LEADERSHIP

This course examines advanced leadership theories and leadership effectiveness in today's organizations. Pre: 1015. (3H,3C)

### 3304: ELEMENTS OF TEAM LEADERSHIP

The focus of this course is to enable students to develop effectiveness in leading, delegating, and communicating within a team environment. An emphasis will be placed on emotional intelligence in teams, team management, and effective team processes. Pre: 1015. (3H,3C)

### 3954: STUDY ABROAD

Variable credit course.

### 3984: SPECIAL STUDY

Variable credit course.

### 4044: LEADERSHIP STUDIES CAPSTONE

Culmination of comprehensive knowledge gained about leadership and social change throughout a student's undergraduate career. Involves reflection on collegiate leadership experiences and coursework in the leadership and social change minor. Results in student development of an electronic portfolio (i.e., ePortfolio). Pre: Senior standing. Pre: 1015. (1H,1C)

### 4754: INTERNSHIP

Variable credit course.

### 4964: FIELD STUDY

May be repeated for a maximum of 6 credits. Variable credit course.

### 4974: INDEPENDENT STUDY

Variable credit course.

### 4984: SPECIAL STUDY

Variable credit course.

### 4994: UNDERGRADUATE RESEARCH

Honors Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Honors Variable credit course.

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# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Aerospace and Ocean Engineering

[Overview](#)

[Degree Requirements](#)

[Undergraduate Course Descriptions \(AOE\)](#)

**Head, Rolls-Royce Commonwealth Professor of Marine Propulsion:** E.G. Paterson

**Assistant Head for Academic Affairs:** R.A. Canfield

**Assistant Head for Laboratory Facilities:** M.K. Philen

**Assistant Head for Graduate Studies:** C.J. Roy

**Fred D. Durham Professor:** J.A. Schetz

**Kevin Crofton Professor:** M.L. Psiaki

**Norris and Laura Mitchell Professor:** R. K. Kapania

**Professors:** A.J. Brown, R.A. Canfield, W.J. Devenport, R.K. Kapania, L. Ma, E.G. Paterson, M.L. Psiaki, P. Raj, C.J. Roy, J.A. Schetz, and C.A. Woolsey

**Associate Professors:** J.T. Black, S. Brizzolara, S. England, M. Farhood, K.T. Lowe, M. Patil, M.K. Philen, G.D. Seidel, and C. Sultan

**Assistant Professors:** C.S. Adams, W.N. Alexander, C.M. Ikeda, S. Choi, L. Massa, B. Srinivasan, K. Vamvoudakis, K.G. Wang, and H. Xiao

**Adjunct Professors:** E.D. Crede and K. A. Shinpaugh

**Professors Emeritus:** E.M. Cliff, W.C. Durham, B. Grossman, E.R. Johnson, J.F. Marchman, W.H. Mason, W.L. Neu, R.L. Simpson, and R. Walters

**Faculty Affiliates:** S. Bailey, R. Batra, R.A. Burdisso, T. Clark, G. Earle, M. Hajj, K. Kochersberger, R. McGwier, W. Scales, D. Stilwell, P. Tarazaga, and L. Watson

Web: [www.aoe.vt.edu](http://www.aoe.vt.edu)

E-mail: [aoe@vt.edu](mailto:aoe@vt.edu)



The Department of Aerospace and Ocean Engineering offers two Bachelor of Science degree programs. Students in the department may major in either aerospace engineering or ocean engineering. Many of the course requirements for these degrees are common, because the two curricula share a broad range of common interests. Both programs offer a wide range of technical electives. Students with an interest in both majors may enroll in a double major program.

The objectives of both of the department's programs include the preparation of students for entry-level positions and graduate study in the fields of aerospace engineering and ocean engineering. The department seeks to provide students with a strong background in fundamentals, including theoretical, experimental, and computational aspects of science and engineering, which will facilitate lifelong learning and the ability to pursue advanced study. It also seeks to provide students with a broad education in the aerospace and ocean vehicle fields encompassing fluid dynamics, vehicle dynamics and control, propulsion, and structures, and including an emphasis on design and synthesis in a team environment.

The department's curricula are vehicle oriented, with an emphasis on aircraft and spacecraft in the aerospace program and on ships of all types in the ocean engineering program. The department's systems engineering approach to these technologies makes them increasingly applicable to other fields, such as the automobile industry, high-speed train design, and other transportation related areas. Departmental graduates find positions in these fields, as well as with the aerospace industry, NASA, the Department of Defense, the ship building industry, and maritime agencies. Employers range from large, multinational corporations to small consulting firms.

Classroom studies employ modern computational techniques. Laboratory classes use the department's outstanding experimental facilities which include a large, research-quality subsonic wind tunnel with a twenty-four-foot-long, six-by-six foot cross section test area and state of the art automated control and data collection systems, a 100-foot-long towing tank, a Mach 4 supersonic wind tunnel, a Mach 7 hypersonic wind tunnel, a water tunnel, a 300-foot long asphalt runway, and several other facilities.

The department encourages students to seek internships and to participate in the Cooperative Education Program, which gives qualified students valuable industrial experience while working toward their engineering degrees. The department's required design courses often include multidisciplinary projects.

The Aerospace Engineering and Ocean Engineering programs are accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org). The department also offers programs of study leading to M. Engr., M.S., and Ph.D. degrees.

AOE students must meet all General Education (Curriculum for Liberal Education) requirements and only certain "free" electives and courses designated as "P/F Only" may be taken on a Pass/Fail basis. Lists of approved electives including technical, math, Liberal Education, and other electives are available on the department's web page: [www.aoe.vt.edu/undergrad/undergrad-advising/index-undergrad-advising.html](http://www.aoe.vt.edu/undergrad/undergrad-advising/index-undergrad-advising.html).

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

# Undergraduate Course Descriptions (AOE)

## 2074: COMPUTATIONAL METHODS

Solving engineering problems using numerical methods and software, truncation and round-off error, root finding, linear and polynomial regression, interpolation, splines, numerical integration, numerical differentiation, solution of linear simultaneous equations. A grade of C- or better is required in the prerequisite. Pre: ENGE 1114 or ENGE 1216 or ENGE 1434. (2H,1.5L,2C)

## 2104: INTRODUCTION TO AEROSPACE ENGINEERING

Introduction to aerospace engineering with foundational material in aerodynamics, propulsion, structures, flight performance, astromechanics, and design. History of aeronautics and astronautics, aircraft and spacecraft types, aircraft and spacecraft components and the atmosphere. Concepts of lift, drag, and steady level flight. Concepts of viscosity and compressibility. Introduction to motion of vehicles and bodies in space. A grade of C- or better is required in each prerequisite. Pre: (ENGE 1114 or ENGE 1216), PHYS 2305. Co: 2074. (2H,1.5L,2C)

## 2114: FUNDAMENTALS OF FLIGHT TRAINING

Foundational course to prepare students with knowledge of basic aeronautics to take the Federal Aviation Administration Knowledge Exam, a requirement for the award of a private pilot's license. Explores airplane systems and functions, flight operations, weather, aeronautical navigation, communications, human factors, and federal aviation regulations. (2H,2C)

## 2204: INTRODUCTION TO OCEAN ENGINEERING

Overview of ocean engineering from a design perspective. Ship types and geometry; stages of ship design; introductory hydrostatics and stability; hydrodynamics; resistance and propulsion; loads on ships; ship structural analysis. A grade of C- or better required in each prerequisite. Pre: (ENGE 1114 or ENGE 1216), PHYS 2305. Co: 2074. (2H,2C)

## 2214: INTRO TO PHYS OCEAN FOR OE

Ocean seafloor properties and dynamics. Properties of seawater. Ocean currents and circulation. Physics of ocean waves and tides. Pre: (ENGE 1114 or ENGE 1216), PHYS 2305. (1H,1C)

## 2974: INDEPENDENT STUDY

Variable credit course.

## 2984: SPECIAL STUDY

Variable credit course.

## 2994: UNDERGRADUATE RESEARCH

Variable credit course.

## 2994H: UNDERGRADUATE RESEARCH

Variable credit course.

## 3014: AERO/HYDRODYNAMICS

Two-dimensional potential flow, stream function, velocity potential, flow superposition, circulation and lift, airfoil characteristics. Two-dimensional airfoil theory and panel methods. Three-dimensional lifting line theory and vortex lattice solutions for finite wings. A grade of C- or better required in each prerequisite. Pre: (3104 or 3204), ESM 2304. (3H,3C)

## 3024: THIN-WALLED STRUCTURES

Review of mechanics of materials. Stresses in stiffened shell beams. Deformation analysis by energy methods. Multicell beams. Introduction to the matrix stiffness method including truss and beam elements. Pre: ESM 2104, ESM 2204. (3H,3C)

## 3034: VEHICLE VIBRATION AND CONTROL

Free and forced motions of first order system. Free and forced motions of second order systems both undamped and damped. Frequency and time response. Introduction to control, transfer functions, block

diagrams, and closed loop system characteristics. Higher order systems. Pre: ESM 2304, (MATH 2214 or MATH 2214H). (3H,3C)

#### 3044: BOUNDARY LAYER AND HEAT TRANSFER

Concepts of viscous flows and physical properties equations of laminar motion with heat and mass transfer; exact and approximate solutions; finite-difference methods; transition to turbulence; analysis in turbulent flows. Conduction and convective heat transfer. Pre: 3014, ME 3134, MATH 4564. (3H,3C)

#### 3054: AOE EXPERIMENTAL METHODS

Principles of measurement and measurement systems; standards, accuracy, uncertainty and statistical concepts. Practical electronics, detectors, transducers and instruments for aerospace and ocean engineering. Signal conditioning systems and readout devices; digital data acquisition, structures, structural dynamics, fluid dynamics, materials and wind-tunnel testing. Pre: 3014, 3024, 3034. (1H,6L,3C)

#### 3094 (MSE 3094): MATERIALS & MANUFACTURING FOR AERO & OCEAN ENGINEERS

This course introduces the student of Aerospace and/or Ocean Engineering to the fundamental properties of materials typically required for structural design. The performance characteristics of metals, ceramics, polymers, and composites are presented and contrasted. Foundation principles underlying materials manufacturing are also presented with the goal of providing an understanding of how processing affects material properties and performance. Must have a C- or better in pre-requisite CHEM 1035. Non-MSE Majors only. Pre: CHEM 1035. Co: ESM 2204, PHYS 2305. (3H,3C)

#### 3104: AIRCRAFT PERFORMANCE

Performance of aircraft. Analysis of fluid statics and dynamics affecting aircraft performance. Hydrostatics of the standard atmosphere and development of basic equations of fluid dynamics. Lift and drag. Aircraft static performance. Rates of climb, endurance, range, take off and landing, and turn performance. Pre: (2104 or 2204), ESM 2104, AOE 2074. Co: 2074, ESM 2304. (3H,3C)

#### 3114: COMPRESSIBLE AERODYNAMICS

Inviscid, compressible gas dynamics. Continuity, momentum and energy equations, shock waves, Prandtl-Meyer expansions. One-dimensional steady and unsteady flow, Rayleigh line, Fanno line, Shock Tubes. Method of Characteristics, supersonic thin airfoil theory and conical flow. Pre: 3014, ME 3134. (3H,3C)

#### 3124: AEROSPACE STRUCTURES

Aspects of structural analysis pertinent to the design of flight vehicles: aeroelastic divergence, environmental loads, aerospace materials, buckling of thinwalled compression members, and introduction to matrix structural dynamics. Pre: 3024. (3H,3C)

#### 3134: STABILITY AND CONTROL

Equations of vehicle motion. Linearized analysis. Estimation of stability derivatives, longitudinal and lateral-directional static stability, and control requirements. Dynamic characteristics including stability and mode shapes. Pre: 3034. (3H,3C)

#### 3204: NAVAL ARCHITECTURE

Buoyancy of ocean vehicles. Hull geometry, line drawings, coefficients of form. Hydrostatic calculations, development of a computer program for hydrostatic analysis. Review and calculations. Intact and damaged stability of ocean vehicles. Large angle stability. Stability criteria. Viscosity. Stress in a fluid. Basic laws of fluid dynamics. Pre: ESM 2104, (MATH 2224 or MATH 2204 or MATH 2204H), (AOE 2104 or AOE 2204). Co: 2074, ESM 2304. (3H,3C)

#### 3224: OCEAN STRUCTURES

Overview of surface ship, submarine and offshore structural systems, materials and loadings. Application of beam and plate bending and buckling theories. Frame and finite element structural analysis. Pre: 3024. (3H,3C)

#### 3264: RESISTANCE AND PROPULSION OF SHIPS

Methods of estimating ship resistance; propulsion devices and their efficiencies; Resistance components; Froude scaling of model test data; Methodical series; Planing hulls; Propellers; Waterjets; Propeller

design; Computer methods; Advanced marine vehicles. Pre: 3204, 3014. (3H,3C)

#### 4004: COMPUTER-AIDED CONTROL SYSTEM DESIGN

Computer-aided design and analysis of control systems for high-order linear systems. Stability and performance design criteria. Root locus, PID, lead/lag, and pole-placement design methods. Introduction to modern state-space modeling methods. Design problems involving aircraft, ship, space, and ground-vehicle systems. Pre: 3034. (3H,3C)

#### 4024 (ESM 4734): AN INTRODUCTION TO THE FINITE ELEMENT METHOD

The finite element method is introduced as a numerical method of solving the ordinary and partial differential equations arising in fluid flow, heat transfer, and solid and structural mechanics. The classes of problems considered include those described by the second-order and fourth-order ordinary differential equations and second-order partial differential equations. Both theory and applications of the method to problems in various fields of engineering and applied sciences will be studied. Pre: (CS 3414 or MATH 3414 or AOE 2074), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). (3H,3C)

#### 4054 (CEE 4444) (ESM 4444): STABILITY OF STRUCTURES

Introduction to the methods of static structural stability analysis and their applications. Buckling of columns and frames. Energy method and approximate solutions. Elastic and inelastic behavior. Torsional and lateral buckling. Use of stability as a structural design criterion. Pre: 3024 or CEE 3404. (3H,3C) II.

#### 4064: FLUID FLOWS IN NATURE

Course designed to build upon and broaden a basic traditional engineering knowledge of fluid flows into areas concerning a variety of natural occurrences and phenomena that involve fluid motions in important ways. Drag of sessile systems and motile animals, gliding and soaring, flying and swimming, internal flows in organisms, low Reynolds number flows, fluid-fluid interfaces, unsteady flows in nature and wind engineering. I Pre: 3014 or CEE 3304 or ESM 3024 or ME 3404. (3H,3C)

#### 4065-4066: AIRCRAFT DESIGN

Analysis and design of various aeronautical vehicles and systems. Pre: 3054, 3114, 3124, 3134 for 4065; 3054, 3114, 3124, 3134, 4065 for 4066. (2H,3L,3C)

#### 4084 (ESM 4084): ENGINEERING DESIGN OPTIMIZATION

Use of mathematical programming methods for engineering design optimization including linear programming, penalty function methods, and gradient projection methods. Applications to minimum weight design, open-loop optimum control, machine design, and appropriate design problems from other engineering disciplines. Pre: (MATH 2224 or MATH 2204 or MATH 2204H). (3H,3C)

#### 4114: APPLIED COMPUTATIONAL AERODYNAMICS

Development of computational methods for application to wing aerodynamic problems. Incompressible airfoil codes. Panel methods and vortex lattice methods. Finite difference techniques. Transonic and supersonic applications. Pre: 3044, 3114. (3H,3C)

#### 4124: CONFIGURATION AERODYNAMICS

Aerodynamic design of flight vehicles, with emphasis on nonlinear flowfields and configuration concepts. Aerodynamic analysis and design for transonic, supersonic, hypersonic flows, and low speed high alpha flight. Includes case studies of classic configurations and aerodynamic design papers. Pre: 3014, 3114. (3H,3C)

#### 4134: ASTROMECHANICS

Application of Newton's Laws to the dynamics of spaceflight. Two-body problem, Kepler's Laws, energy and time relations, orbit specification and determination. Orbital maneuver and transfer, patched conic approximations, relative motion, and elements of optimal maneuvering. Pre: ESM 2304. (3H,3C)

#### 4140: SPACECRAFT DYNAMICS AND CONTROL

Space missions and the way pointing requirements affect attitude control systems. Rotational kinematics and attitude determination algorithms. Modeling and analysis of the attitude dynamics of space vehicles. Rigid body dynamics, effects of energy dissipation. Gravity gradient, spin, and dual spin stabilization. Rotational maneuvers. Environmental torques. Impacts of attitude stabilization techniques on mission

performance. Pre: 3034, 4134. (3H,3C)

#### 4154: AEROSPACE ENGINEERING LABORATORY

Wind tunnel laboratory experiments related to subsonic and supersonic aerodynamics. Continuation of AOE 3054 for Aerospace Engineering students. Writing of technical laboratory reports; design of experiments. Pre: 3054, 3114, 3124, (3134 or 4140). (3L,1C)

#### 4165-4166: SPACECRAFT DESIGN

Analysis and design of various space vehicles and systems. Pre: 3054, 3114, 3124, 4140 for 4165; 3054, 3114, 3124, 4140, 4165 for 4166. (2H,3L,3C)

#### 4174 (ME 4174): SPACECRAFT PROPULSION

Spacecraft propulsion systems and their applications in orbital, interplanetary, and interstellar flight. Rocket propulsion fundamentals; advanced mission analysis; physics and engineering of chemical rockets, electrical thrusters, and propellantless systems (tethers and sails); spacecraft integration issues. Pre: 4234 or ME 4234. (3H,3C)

#### 4214: OCEAN WAVE MECHANICS

Introduction to theory of wave motion in different water depth regions, including wave generation and propagation. Description of wave statistics and spectral representation for realistic ocean conditions. Wave forces on stationary structures. Nonlinear waves, wave properties, and methods of analysis. Pre: 3014, MATH 4564. (3H,3C)

#### 4234 (ME 4234): AEROSPACE PROPULSION SYSTEMS

Design principles and performance analysis of atmospheric and space propulsion engines and systems. Application of thermodynamics, compressible fluid flow and combustion fundamentals to the design of gas turbine and rocket engines and components, including inlets, turbomachines, combustors, and nozzles. Matching of propulsion system to vehicle requirements. Pre: (3114, ME 3134) or (ME 3404, ME 3124). (3H,3C)

#### 4244 (ME 4244): MARINE ENGINEERING

Analysis of major ship propulsion devices (propellers, water jets). Integration with propulsion plant and machinery. Characteristics of marine steam turbines, nuclear power plants, marine diesels, and marine gas turbines. Shafting system, bearings, and vibration problems. Pre: 3204, (ME 3134 or ME 3124). (3H,3C)

#### 4254: OCEAN ENGINEERING LABORATORY

Continuation of AOE 3054 for Ocean Engineering students using facilities and instrumentation pertinent to ocean engineering. Writing of technical laboratory reports; design of experiments. Pre: 3054, 3264. (1H,2L,1C)

#### 4264: PRINCIPLES OF NAVAL ENGINEERING

This course studies naval engineering systems and systems engineering processes with particular emphasis on: naval missions; combat system performance including radar; underwater acoustics and sonar; ballistics; weapon propulsion and architecture; weapons effects; ship survivability including underwater explosion and shock waves; surface ship and submarine balance and feasibility analysis; and total ship integration. Senior Standing required. Pre: (2204 or 3204), (MATH 2224 or MATH 2204 or MATH 2204H), PHYS 2306. (3H,3C)

#### 4265-4266: SHIP DESIGN

Study and application of systems engineering process to simultaneous development of ship requirements, concept exploration, selection of ship technologies, and selection of a baseline ship design. Emphasis is on hullform, machinery, ship synthesis and balance, metrics and design optimization in the context of a ship design project. Baseline design selected in the first semester is developed in the second semester. This includes hullform; topside arrangements; internal subdivision and tankage; power and propulsion; auxiliary machinery, general arrangements, machinery weights, space, seakeeping, cost, risk, and overall balance and feasibility. Pre: 3054, 3224, 3264, 4214, 4244 for 4265; 3054, 3224, 3264, 4214, 4244, 4265 for 4266. Co: 4334 for 4265. (2H,3L,3C)

#### 4274: COMPUTER BASED DESIGN OF OCEAN STRUCTURES

Computer-based structural models for combined finite element analysis, limit state analysis and optimization. Torsion of thin-walled structures. Buckling of stiffened panels and cylinders. Eigenvalue methods for buckling and vibration. Incremental plastic collapse; other progressive collapse. Ultimate strength of large structural modules. Pre: 3224. (3H,3C)

#### 4334: SHIP DYNAMICS

Analysis of motions of rigid body vehicles in water, including influence of added mass and buoyancy. Seakeeping motion responses in waves, wave-induced structural loads, random response analysis via spectral analysis, and extreme response analysis. Introduction to hydroelasticity and maneuvering. Pre: 3014, 3034, 4214, MATH 4564. (3H,3C)

#### 4344: DYN OF HIGH-SPEED MARINE CRAFT

Introduction to the dynamics of high-speed craft, including surface effect ships, hydrofoil vessels, semi-displacement monohulls and catamarans, and planing vessels. Pre: 3264, 4334. (3H,3C)

#### 4404 (MATH 4404): APPLIED NUMERICAL METHODS

Interpolation and approximation, numerical integration, solution of equations, matrices and eigenvalues, systems of equations, approximate solution of ordinary and partial differential equations. Applications to physical problems. Partially duplicates 3414. Mathematics majors or minors cannot take both 4404 and 3414. X-grade allowed. Pre: MATH 4564, (ESM 2074 or AOE 2074). (3H,3C)

#### 4414: COMPUTER-AIDED SPACE MISSION PLANNING

Design and analysis of space missions. Basic orbital mechanics and access between spacecraft and ground station. Advanced orbit visualization. Prediction of spacecraft position observation under constraints. Communications and link budgets. Terrain modeling and impact on performance. Constellation design and coverage. Orbital perturbations. Dynamics of airplanes and space launch vehicles. Interplanetary mission design. Pre: 2074, (4134 or ECE 2164). (1H,1C)

#### 4434: INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS

Euler and Navier-Stokes equations governing the flow of gases and liquids. Mathematical character of partial differential equations. Discretization approaches with a focus on the finite difference method. Explicit and implicit solution techniques and their numerical stability. Introduction to verification, validation, and uncertainty quantification for computational fluid dynamics predictions. Co: AOE 3044 or ME 3404 or ESM 3016. Pre: MATH 2214. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

### Animal and Poultry Sciences

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[Undergraduate Course Descriptions \(APSC\)](#)

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**Head:** David E. Gerrard

**John W. Hancock, Jr. Professor:** E. A. Wong

**Paul Mellon Distinguished Associate Professor of Agriculture:** S. E. Johnson

**Professors:** D. M. Denbow, E. A. Dunnington, M. J. Estienne, D. E. Gerrard, S. P. Greiner, H. Jiang, J. W. Knight, E. J. Smith, and E. A. Wong

**Associate Professors:** R. A. Dalloul, A. D. Ealy, D. E. Eversole, S. E. Johnson, R. R. Rhoads Jr., R. K. Splan, and C. M. Wood

**Assistant Professors:** M. A. Cline, S. W. El-Kadi, E. R. Gilbert, K. Lee, C. M. Leeth, V. Mercadante, M. E. Persia, and M. A. Rhoads

**Instructors:** L. Bergamasco and N. Tamim

**Lecturer:** C. C. Crisman, B. J. McIntosh, L. C. Nulton, S. West, and T. B. Wilson

**Research Assistant Professor:** H. Shi

**Adjunct Professor:** P. A. Harris

**Career Advisors:** J. S. Bradley, D. M. Denbow, E. A. Dunnington, D. E. Eversole, and N. Tamim

Web: [www.apsc.vt.edu](http://www.apsc.vt.edu)

E-mail: [apsc@vt.edu](mailto:apsc@vt.edu)

### Overview

The Department of Animal and Poultry Sciences provides students with a broad science-based education tailored to meet their needs and career goals. The program prepares students for careers in livestock,

poultry, equine, companion animals, laboratory animals, agribusiness, research, and teaching. The curriculum also provides preparation for professional schools including veterinary medicine, medical school and other health professions, graduate school, etc. This major combines education in the basic sciences of animal and poultry nutrition, genetics, and physiology with management principles as applied to the raising and merchandising of beef cattle, horses, poultry, sheep, swine, and their products. Undergraduate students are encouraged to participate in independent studies, undergraduate research, and internship programs. Study abroad opportunities are also available.

Students choose among three options: production/business, science, or pre-vet. Within each option, emphases are offered in the areas of equine, livestock, poultry, and companion/laboratory animals. Specific requirements may be obtained from the departmental advising office (540/231-6936), by e-mail ([apsc@vt.edu](mailto:apsc@vt.edu)), or on the web at [www.apsc.vt.edu](http://www.apsc.vt.edu).

The department also offers opportunities for graduate specialization in the following fields: nutritional physiology, genetics and genomics, immunology and health, growth and development, animal management and environmental interactions. M.S. and Ph.D. programs are offered (see [Graduate Catalog](#)).

## Course Requirements for Majors

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

**Note:** Advisors work with students to individualize the course of study.

\* Electives must include Area 2, Area 6 and Area 7 selections; 38 emphasis requirements & restricted electives approved by student advisor; and a maximum of 12 credits of free electives.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Animal and Poultry Sciences.

Satisfactory progress requirements toward the B.S. in Animal and Poultry Sciences can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (APSC)

### 1454: INTRODUCTION TO ANIMAL & POULTRY SCIENCE

Survey of systems of livestock and poultry production including: concepts and terminology pertaining to management and marketing; types and breeds of livestock and poultry; and an introduction to nutrition, genetics, physiology, and management of beef cattle, horses, sheep, swine and poultry. (3H,3C)



#### 1464: ANIMAL AND POULTRY SCIENCE LABORATORY

Management practices and concepts related to efficient livestock and poultry production and marketing are taught through demonstrations and hands-on experience. Co: 1454. (3L,1C)

#### 1504: ANIMAL AND POULTRY SCIENCES FIRST YEAR EXPERIENCE

Orientation course for freshman and transfer APSC students providing skills, resources and fundamental knowledge to enhance learning experiences and support success. Skills, resources, opportunities, curriculum, and career planning. Emphasis on inquiry, problem-solving skills, critical thinking and integration of ideas and experiences to encourage life-long learning. (1H,1C)

#### 1524: BEGINNING EQUITATION

Introduction to modern forward seat equitation. No previous experience necessary. Familiarization with parts of the horse, tack, gaits. Control at walk, trot, canter, including trot work over rolling terrain. Pass/Fail only. (4L,1C)

#### 1624: LOW INTERMEDIATE EQUITATION

Increased riding at canter and sitting trot. Control of horse over moderately difficult terrain including galloping. Beginning cavelletti work. Pass/Fail only. Pre: 1524. (4L,1C)

#### 2004: ANIMAL AND POULTRY SCIENCES SEMINAR

Identification of primary and secondary career objectives for Animal and Poultry Science majors; planning for completion of a capstone learning experience in the major. Identification of curricular and extracurricular activities to increase career opportunities. Improvement of professional and technical writing skills applicable to the animal sciences field. Pre: 1504. (1H,1C)

#### 2104: POULTRY LABORATORY

Anatomy and physiology of birds including species-specific specializations in anatomical structure and body composition, musculoskeletal, respiratory, reproductive, endocrine, digestive and urinary systems. Relationship of these concepts to growth and egg production. Includes handling live birds. Pre: 1454, 1464. Co: ALS 2304. (3L,1C)

#### 2114: LIVESTOCK MANAGEMENT AND HANDLING

Safety in livestock handling; animal behavior; care, housing, and managerial practices related to beef cattle, sheep, and swine taught through experiential activities. Pre: 1454, 1464. (3L,1C)

#### 2124: HORSE MANAGEMENT LABORATORY

Principles of safe horse handling practices and applied horse management skills, taught through experiential activities. Pre: 1454, 1464. (2L,1C)

#### 2164: COMPANION AND LABORATORY ANIMAL CARE AND HANDLING

Brief history of companion and laboratory animals. Outline of the major anatomical and physiological characteristics, first aid and basic care. Principles of husbandry and handling techniques. Institutional Animal Care and Use Committee training. Pre: 1454, 1464. (2L,1C)

#### 2424: INTRODUCTION TO THE EQUINE INDUSTRY

Introduction to the horse and equine industry. Survey of breeds and conformation; breeding, management, equipment, facilities, and marketing of the successful horse operation. (3H,3C)

#### 2464: INTRODUCTION TO COMPANION ANIMALS

Appropriate care and resulting well-being of dogs, cats, and other animals that are used primarily for companionship and recreation require knowledge of their evolution, natural habitats, species and breed characteristics, behavior, breeding, feeding, housing and training. This course integrates these topics to promote a symbiotic human-animal relationship. Information regarding the scope and impact of the companion animal industry will be discussed along with a survey of associated careers. Pre: BIOL 1106. (2H,2C)

#### 2524: INTERMEDIATE EQUITATION

Intermediate work in horseback riding with special emphasis on development of the forward seat and skills required for jumping. Elementary dressage movements. Pass/Fail only. Pre: 1624. (4L,1C)

#### 2624: BEGINNING EQUITATION OVER FENCES

Introduction of jumping skills for the unskilled as well as review of jumping skills for experienced riders. Rider should have skills at trot and canter. Pass/Fail only. Pre: 2524. (4L,1C)

#### 2824: EQUINE CONFORMATION AND BIOMECHANICS

Evaluation of equine conformation as related to locomotion, athletic performance and soundness. Basic understanding of breed standards, gaits, and rules and regulations pertaining to various equine sports disciplines, from both domestic and global perspectives. Investigation of current scientific literature regarding equine conformation and biomechanics. (1H,2L,2C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Pass/Fail only. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3064: COMPANION AND LABORATORY ANIMAL SCIENCE

Comparative aspects of companion and laboratory animals including physiology, anatomy, nutrition, genetics and reproduction. Normal behaviors along with techniques of behavior modifications. Pre: ALS 2304. (3H,3C)

#### 3134 (DASC 3134): ANIMAL AGRICULTURE AND THE ENVIRONMENT

Environmental issues associated with animal agriculture. Nutrient contamination of water resources, odor emission from livestock farms, environmental regulations affecting animal agriculture, and management practices to reduce the impacts of livestock farms on air and water quality. (3H,3C)

#### 3214 (FST 3214): MEAT SCIENCE

Fundamentals of meat science in meat inspection, carcass evaluation, fabrication, fresh meat, processed meat and product preservation on beef, pork, lamb, poultry and seafood. Physical, chemical, physiological, and microbiological properties of meat as related to composition and quality. Fundamentals in processing techniques, product quality assurance, and food safety programs in meat industries. Pre: ALS 2304, CHEM 1036. (2H,4L,4C)

#### 3254: ANIMAL PRODUCTS

Products obtained from animals (meat, eggs, dairy, by-products). Effect of production and processing of food animals upon product safety and quality. Pre: ALS 2304. (2H,2L,3C)

#### 3304: EMBRYOLOGY

Normal and teratological embryology are intensively examined from ovulation through hatching or birth. Environmental, nutritional and genetic factors affecting embryogenesis. Even years. Pre: ALS 2304 or BIOL 3404. (2H,3L,3C)

#### 3334: ANIMAL WELFARE AND BIOETHICS

Historical overview of animal welfare and bioethics. Animal welfare issues in farm and companion animals with respect to their use and treatment in the United States and in the global community. The influences of animal protection organizations, consumer groups, politicians, the scientific community, and other stakeholders on the development and enforcement of policies. Pre: Junior Standing. Pre: 1454, ALS 2304. (3H,3C)

#### 3514: ANIMAL GROWTH, DEVELOPMENT AND EVALUATION

A study of animal growth and developmental processes, micro and gross anatomy, and body and carcass composition. Factors affecting myogenesis, adipose and bone growth. Pre: ALS 2304. (2H,2L,3C)

#### 3524: INTERMEDIATE EQUITATION OVER FENCES

Establishment of sound jumping skills. Continuation of more advanced flat work. Study of hunter courses and cross country jumping. Pass/Fail only. Pre: 2624. (4L,1C)

#### 3624: ADVANCED EQUITATION OVER FENCES

Advanced methods and techniques for jumping and precision riding. Pass/Fail only. Pre: 3524. (4L,1C)

#### 3684: SPECIAL TOPICS IN ANIMAL AND POULTRY SCIENCES

An advanced, variable-content course which explores a topic in the animal sciences such as a significant contemporary issue; an emerging research area of interest to undergraduates; or a semester-long project involving a small group of students. May be repeated for up to three credits, no more than two credits per term. Pass/Fail only. Pre: ALS 2304. (1H,2H,2C)

#### 3724: APPLIED EQUINE EVALUATION

In-depth analysis of equine conformation and performance. Emphasis on knowledge of breed standards, critical thinking skills, and oral justification of decisions. Equivalent experience may be substituted for the pre-requisite APSC 2824 with instructor approval. Pre: 2824. (1H,3L,2C)

#### 3754: PRINCIPLES OF LIVESTOCK EVALUATION

Selection of market and breeding animals based on subjective and objective methods of evaluation. Basic understanding of evaluation principles, form-to-function, expected progeny differences, and performance records of beef cattle, swine, and sheep. Involves accurate decision making and oral reason presentations. Pre: 1454. (6L,2C)

#### 3764: LIVESTOCK MERCHANDISING

A comprehensive study of the principles and activities involved in successfully promoting and merchandising livestock. A livestock auction (Hokie Harvest Sale) is held at the conclusion of the course to provide experiences in advertising, salesmanship, livestock photography, facility development, sale management, and budgeting. Pre: Junior standing or consent. (2H,2C)

#### 3824: EQUINE BEHAVIOR AND TRAINING

Psychology and ethology of equine behavior. Application of fundamental behavioral concepts to the training of horses and modification of undesirable behavior patterns. Preparation and presentation of young horses for show and sale. Pre: 2124. (1H,3L,2C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4004: CONTEMPORARY ISSUES IN THE ANIMAL SCIENCES

Applying critical thinking and problem solving to important contemporary issues in animal agriculture and other areas of animal sciences; practice in visual, oral, and written communication. Pre: 2004. (1H,2L,2C)

#### 4054 (BCHM 4054): GENOMICS

A 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. Pre: BCHM 3114 or BCHM 4116 or BIOL 3774. (3H,3C)

#### 4064: ISSUES IN COMPANION ANIMAL MANAGEMENT

Comparative aspects of companion animals including physiology, anatomy, nutrition, genetics, reproduction and well-being. Normal and aberrant behaviors along with techniques of behavior modification and pharmacological intervention. Critical evaluation of current legal and ethical issues in the companion animal industry. Limited to dogs, cats and caged birds. Pre-requisite: Junior Standing required. Pre-requisites may be waived with permission of instructor. Pre: 2464, ALS 3104, ALS 2304. (3H,3C)

#### 4124: EQUINE HEALTH AND DISEASE

Application of principles needed to effectively monitor and manage equine herd health. Focus on information synthesis, situation assessment and decision-making skills to develop preventative care protocols and treat illness. Practical application of horse health care techniques for routine and minor emergency situations. Pre: ALS 2304. (2H,4L,4C)

#### 4224: EQUINE EXERCISE PHYSIOLOGY

Comprehensive study of conditioning the equine athlete using the principles of exercise physiology, energetics, kinetics, and sports medicine. Anatomy and physiology as it relates to exercise, conditioning and fitness assessment; exercise intolerance; performance nutrition; and medical practices used to support equine athletics. Pre: ALS 2304. (3H,3C)

#### 4304 (DASC 4304): BOVINE REPRODUCTION PRACTICES

Principles and techniques in reproductive physiology and herd management related to health, record keeping, estrus detection and synchronization, uterus and ovary condition. Ovarian function and superovulation, semen handling, artificial insemination and pregnancy detection are also considered. Pre: ALS 2304. (1H,3L,2C)

#### 4324: EQUINE REPRODUCTION AND NEONATAL CARE

Principles and techniques in equine reproductive physiology and endocrinology. In-depth examination of equine reproduction strategies combined with practical techniques leading to synthesis and evaluation of breeding decisions. Anatomy and physiology of the mare and stallion, estrus detection and manipulation, artificial insemination, semen handling and processing, parturition and early care of neonates will be covered. Other topics will include selection of breeding stock and mating decisions. Pre: ALS 2304. (2H,4L,4C)

#### 4404: COMMERCIAL POULTRY ENTERPRISE MANAGEMENT

Production, management, and reproduction of meat- and egg-type chickens and turkeys. Emphasis is on the application of basic poultry science principles as they relate to commercial poultry enterprises. Advanced topics of economic analysis, program management, and problem solving used in decision making processes in integrated poultry operations. Pre: 2104, ALS 3104, ALS 3204, ALS 3304. (3H,3L,4C)

#### 4414: BEEF AND SHEEP PRODUCTION AND INDUSTRY

Study of the commercial and purebred beef cattle and sheep industries. Principles and applications for successful and profitable beef and sheep production. Pre: 2114, ALS 3104, ALS 3204, ALS 3304. (3H,3L,4C)

#### 4424: HORSE PRODUCTION AND MANAGEMENT

Reproduction, genetics, nutrition, herd health, planning and economics of private and commercial horse farms, and current issues in the horse industry. Pre: 2124, 2424, ALS 3104, ALS 3204, ALS 3304. (3H,3L,4C)

#### 4444: SWINE PRODUCTION

Principles for commercial and seedstock swine production; current management practices, housing and marketing; issues and challenges in the swine industry. Experience in husbandry, research, and other management techniques obtained during laboratory. Pre: 2114, ALS 3104, ALS 3204, ALS 3304. (2H,3L,3C)

#### 4464: COMPANION AND LABORATORY ANIMAL HEALTH AND MANAGEMENT

Animal health, management, well-being, and government regulation in the maintenance, use and enjoyment of companion and laboratory animals. Pre: 2164, 3064, ALS 3104, ALS 3204, ALS 3304. (3H,2L,4C)

#### 4554: ADVANCED LIVESTOCK ENTERPRISE MANAGEMENT

Application of principles needed to manage profitable and sustainable beef cattle, sheep, and swine enterprises. Use of techniques to develop and evaluate strategies resulting in sound livestock enterprise management decisions. Focus on advanced animal management protocols, enterprise analysis, resource allocation, marketing options and risk management. Pre: (AAEC 3404 or AAEC 3454), (APSC 4414 or APSC 4444). (2H,2L,3C)

#### 4624: TOPICS IN EQUINE SCIENCE

Review and critique of scientific literature related to equine science. Focus on creative and critical thinking. Principles and practice of information analysis, synthesis and evaluation through discourse and

technical writing. Practical application of research and communication skills. Pre: ALS 2304. (2H,2C)

**4954: CAPSTONE EXPERIENCE IN ANIMAL AND POULTRY SCIENCES**

Student-defined learning experience that utilizes knowledge and skills already learned to acquire new skills, synthesize information and solve problems in the animal sciences. Requires approval from the department before commencement of the experience, and a final report at its conclusion. Open to APSC majors only. Completion of 75 credits towards the APSC degree required. Pass/Fail only. Variable credit course. Pre: 2004.

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Pass/Fail only. Variable credit course.

**4974H: INDEPENDENT STUDY**

Pass/Fail only. Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Pass/Fail only. Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Pass/Fail only. Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Architecture

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### Overview

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**Director - School of Architecture & Design:** H. de Hahn

**Chair - Foundation Program** J. Bassett

**Chair - Core Professional Program:** D. Dugas

**Chair - Advanced Professional Program:**H. Schnoedt

**Chair - Graduate Program:**H. Pittman

**Professors:** K. Albright, M. Breitschmid, S. Choudhury, A.J. Davis, H. de Hahn, D. Dunay, R. Dunay, P. Emmons, J. Holt, J. Jones, S. Piedmont-Palladino, H.L. Rodriguez-Camilloni, H. Rott, R. Schubert, M. Setareh, F. Weiner, and J. Wheeler

**Associate Professors:** J. Bassett, H. Bryon, M. Cortes, D. Dugas, K. Edge, M. Ermann, M. Feuerstein, W. Galloway, S. Gartner, E. Grant, S. Martin, M. McGrath, H. Pittman, H. Schnoedt, and S. Thompson

**Assistant Professors:** P. Doan, A. Ishida, N. King, and P. Zellner-Bassett

**Visiting Instructors:** L. McGuire, C. Pritchett, and C. Vorster

**Instructors:** R. Holt

**Adjunct Instructors:** S. Bitar, D. Lever, R. Mars, M. Paget, D. Regan, J. Schippers, and D. Snook

**Professor Emeritus:** W. Brown, R. Chiang, D. Egger, W. Kark, D. Kilper, F. Ruiz, D. Sunshine, J. Wang, S. Poole, and R. Daniel

**Associate Professor Emeritus:** D. Jones

**Assistant Professor Emerita:** E. Braaten

Web: [www.archdesign.vt.edu](http://www.archdesign.vt.edu)

## Overview

Architecture enriches our lives by offering us environments that are sensibly compelling, thought provoking, and capable of lifting our spirits. In addition to being beautiful, architecture is, by ancient definition, functional and durable. Like art, architecture is permeated by dualities. It is stable and transitory, measurable and immeasurable, and capable of both being touched and touching us. Like science, architecture involves systematic study. Its methods are iterative, experimental, and rely on intense observation. By intertwining the poetic and practical, architecture is uniquely poised to address the challenges of contemporary life and build the culture of the 21st century.

The professional curriculum in architecture requires five years of study for the first professional degree, the Bachelor of Architecture (B. Arch.).

The first professional degree programs at Virginia Tech, the five-year Bachelor of Architecture degree (B. Arch.), the Master of Architecture II (M.Arch.2), and the Master of Architecture III (M.Arch.3) degrees, are fully accredited for the current maximum six-year term of accreditation by the National Architectural Accrediting Board.

All students in the School of Architecture + Design - Architecture, Industrial Design, Interior Design and Landscape Architecture - begin their studies in a common first year foundation program. Following the foundation program, students pursue professional studies in the 2-3 and 4-5 programs.

## Foundation Design Program - First Year

Foundation Design Lab is an immersive, interactive learning environment focused on inquiry, experimentation, discovery, and synthesis for students studying architecture, landscape architecture, interior design, and industrial design. The design lab develops self-reliance and self-critique, opens intellectual horizons, and challenges students to continually expand and deepen their aesthetic judgment and critical understanding. Studies are undertaken in two and three dimensions across multiple scales.

## Professional Program - Second, Third, Fourth, and Fifth Years

The Professional Program employs design theory and processes to study the design of buildings. Students conduct an interactive investigation of architectural space, environmental forces, and building technology. Foundations of discipline-specific knowledge are progressively introduced, discussed, and examined as they contribute to the complex totality of a work of architecture. Students explore natural and cultural forces as they relate to architecture through means of representation specific to the discipline. With architecture at the core, the program examines interdisciplinary sources such as art, science, and philosophy for the purpose of establishing the content the discipline shares with other forms of knowledge.

Concepts in the Professional Program are communicated through both traditional drawings and models, as well as through modern virtual tools and digital production. All coursework seeks to develop the ability to conduct a professional written and verbal discourse. Further emphasis is placed on intellectual discipline, constructive dialogue, assertion of interest, and a self-motivated search for critical issues.

The **second year** is characterized by an increase in the complexity of design exercises to foster a better understanding of the interplay between situation, time and desired spatial definition. Architectural constructs of smaller scales build on knowledge of basic design principles studied in the first year. The laboratory discourse focuses on principal elements of architecture and their compositional and material role in space. Architecture as the art of building is conveyed through the detailed study of exemplary built works.

The **third year** provides for study of fundamental design principles, technical concepts and their

applications, including measures of quality in architecture. The instructional content of this year articulates and communicates to students the unique nature of architecture through the study of interrelationships of material, construction systems, site, and building programs. The Architecture III design laboratory guides the student's growing experience with practical design problems and provides order to the gradual exploration and learning of the nature and means of achieving architecture. Associated with Architecture III are lectures, presentations, and workshops intended to challenge students toward sensible integration of necessary systems and legal responsibilities in the design and construction of buildings.

The **fourth year** builds on the increased comprehension of building systems acquired during the third year. On-campus or off-campus, the aim of the various program options is to promote an in-depth understanding of the relationship between architectural idea and physical building form. On-campus students are offered studio courses with various focus topics. Off-campus options include several VT and non-VT Study Abroad Programs, the Extern Program, the Washington-Alexandria Center, or the Chicago Studio.

Off-campus programs directed by the Virginia Tech School of Architecture + Design include:

- *The Europe Study Abroad Fall Travel Program* studies seminal European historic and contemporary architectural works and urban spaces, which are visited and documented with analytical drawings, sketches, and photographs, supplemented by on-site lectures by architects and professionals. Documented research before and after the program leads students to greater depth of understanding of the issues surrounding the architecture.
- *The Steger Center Residency Program*: Each semester, 16 architecture students take part in this program at Virginia Tech's European Steger Center for International Scholarship in Riva San Vitale, Switzerland. An 18th century villa and its gardens on the southern tip of Lake Lugano provide residence and dining facilities for Architecture + Design students, as well as 30 Virginia Tech students from other academic disciplines. Studio work, courses, research, and travel are directed to advance first-hand knowledge of the architecture, geography, and culture of Europe.
- *The Chicago Studio*: Hosted by significant architecture firms in downtown Chicago, this 4th-year off-campus semester seeks to integrate education and practice in a direct way. Its distinctive structure and curriculum is centered around urban focused studio and course work, with direct input from the profession. Site visits in the Chicago metropolitan area and the lectures and events of the active architecture culture of Chicago contribute significantly to this program.
- *Professional Extern Program* allows students to spend one semester in an approved professional setting and receive up to 12 hours of academic credit. This program provides a valuable link between the academic environment and architectural practices, discipline-related government agencies, and other design offices throughout the world.
- *The Washington-Alexandria Architecture Center* affords students from the School of Architecture + Design and from related College disciplines the opportunity to study with students and faculty from a national and international consortium of schools in the historic urban context of Old Town Alexandria. The Center complex offers studio space, classrooms, exhibition and review spaces, shops, and computer labs for the students and faculty of the consortium. The University also offers a limited number of apartments for students studying at the Center.

In the **fifth year**, students conduct a yearlong advanced study with individual faculty advisors. The in-depth engagement with research, theory, and design is intended to broaden a student's expertise in a particular area within the field of architecture. Fifth-year students are expected to formulate and accomplish advanced high-level work in the form of a terminal project. Working with their advisors, students develop and discuss their research and design progress, and have periodic formal peer reviews throughout the year. Students are required to leave the project documentation of their 5th-year work with the school upon graduation.

The first professional degree programs (B.Arch., M.Arch.2 & M.Arch.3) in architecture are accredited by the National Architectural Accrediting Board (NAAB).



- 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 U.S. 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.
- Doctor of Architecture and Master of Architecture 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.
- Next accreditation visit for all programs: 2018

The four-year, pre-professional degree is not offered at Virginia Tech.

## Program Requirements

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

### Graduation Requirements

Upon successful completion of program requirements of the foundation level of study and the professional levels of study in architecture and with completion of 160 credit hours of study, a first professional degree of Bachelor of Architecture is awarded.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Urban Affairs and Planning.

Satisfactory progress requirements toward the degree can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (ARCH)

### 1014: INTRODUCTION TO ARCHITECTURE: LESSONS IN FORM & CULTURE

Introduction to the discipline of architecture for non-architecture majors. Emphasis on the basic elements of design and the relationships of a culture to the forms, shapes, and structures it expresses in architectural production. (3H,3C)

### 1015-1016: FOUNDATION DESIGN LABORATORY

Introduction to the discipline of architecture. Focus on basic elements of design, addressed visually,

conceptually, and haptically. Studies undertaken in two and three dimensions using various materials and tools. Inquiry into the process of design, discovering, through experiment, methods of working that develop aesthetic judgment and means of self-evaluation. Emphasis on intellectual discipline, dialogue, assertion of interest, and a self-motivated search for critical issues. (2H,12L,6C)

#### 1024: INNOVATIVE DESIGN THINKING

Engages students in learning environment of the design laboratory, which is interactive inquiry, experimentation, discovery, and synthesis. Develops thinking and making skills in 2D and 3D across multiple scales. Advances abilities to solve problems through exploring strategies with viable consequences. Engages students in a series of iterative drawing, and modeling exercises relevant to architecture and design education. ARCH 1024 is restricted to incoming freshmen. (3H,3C)

#### 1034: SEEING DESIGN: TRANSFORMING OBSERVATIONS

Introduces students to ways of perceiving, and recording the built and natural environment in Southwest Virginia. Introduces students to travel studies as an essential part of their architecture and design education. Transforms students' observational skills. Employs photography and sketching as means of documenting findings. Employs screenprinting and digital technologies as a way to transform documentation. Prepares students for an exhibition of their work, including oral presentations. ARCH 1034 is restricted to incoming freshmen. (3H,3C)

#### 1115-1116: QUALIFYING DESIGN LABORATORY

1115: An immersive, interactive course focused on inquiry, experimentation, discovery, and synthesis. Employs a series of iterative drawing and modeling exercises, at a beginner's level, in two and three dimensions across multiple scales. Develops self-reliance and self-critique, which opens intellectual horizons. Challenges expand and deepen aesthetic judgment and critical understanding. Develops fundamental thinking and making skills that advance their abilities to solve problems by exploring strategies toward viable consequences. Restricted to students transferring into the School of Architecture + Design and changing their major to architecture, landscape architecture, interior design, or industrial design. 1116: An immersive, interactive course focused on inquiry, experimentation, discovery, and synthesis. Employs a series of iterative drawing and modeling exercises, at an intermediate level, in two and three dimensions across multiple scales. Develops self-reliance and self-critique, which opens intellectual horizons. Challenges expand and deepen aesthetic judgement and critical understanding. Advances foundational thinking and making skills that develop their abilities to solve problems by exploring strategies toward viable consequences. Restricted to students transferring into the School of Architecture + Design and changing their major to architecture, landscape architecture, interior design, or industrial design. (1H,6L,3C)

#### 2015-2016: ARCHITECTURE II

Introduction to the discipline of architecture, isolating and intertwining fundamentals that contribute to the complex totality that constitute a work of architecture. Explores how architecture concentrates and conveys natural and cultural forces through means specific to the discipline. Focus on fundamentals realized artistically and practically in works by selected architects. Articulates the unique reality of architecture through the study of basic interrelationships of material, construction, site, and program. Introduces the complex interplay of situation, space and time in the making of places. Examines interdisciplinary sources such as art, science, and philosophy for the purpose of establishing the content architecture shares with other forms of knowledge and how that content, expressed through architecture, contributes to human well-being. Concepts communicated through drawings and models. Emphasis on intellectual discipline, dialogue, assertion of interest, and a self-motivated search for critical issues. Pre: 1016. (2H,12L,6C)

#### 2034: ART OF BUILDING

Introduction to contemporary building construction practices and conventions, addressing and examining the physical making of buildings. Constructive conditions will be presented and analyzed based on the materials, assemblies, details, performance, and programmatic requirements that inform and comprise a building's physical reality. Pre: 2044. (2H,2C)

#### 2044: BUILDING MATERIALS

Introduction to the attributes of materials with which buildings are built such as masonry, reinforced

concrete, steel, stone, timber, glass and insulation; introduction of the impact of soil, vegetation, watersheds and other natural conditions on buildings and their material fabrication. Pre: 1015. (2H,2C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3015-3016: ARCHITECTURE III

First design laboratory for the Professional Program in Architecture. Provides for exploratory investigation and analysis of the fundamental design principles, technical concepts and applications, and the measures of quality in architecture. Co: 3045 for 3015; 3054, 3046 for 3016. (1H,12L,6C)

#### 3045-3046: BUILDING ASSEMBLIES

The designs of building assemblies, elements, systems and sub-assemblies are studied. Building assemblies as controlled by formal idea, geometry, construction, materials, details, structure, function, enclosure, and finish work are considered. Pre: 2016. Co: 3015 for 3045; 3054, 3016 for 3046. (2H,2C)

#### 3054: BUILDING ANALYSIS

Study of exemplary built works of architecture through analysis of design documents, interviews, and inspection of actual construction. Course is completed as a group project resulting in both an oral presentation and a written document. Pre: 3015. Co: 3046, 3016. (2H,2C)

#### 3115,3116: HISTORY OF ARCHITECTURE

A review of world architecture, predominantly but not exclusively with reference to Occidental building art. The study of principles concepts and representations of buildings and structures from the 4,000 BC to the present through reading, drawing, and writing are important aspects of the course. Pre: 1016 for 3115; 3115 for 3116. (3H,3C)

#### 3514: DESIGN-RELATED MEDIA

Properties and uses of various media, materials and processes as tools for analysis, documentation and presentation of the designed environment. Basic skills and techniques relating to photography, printmaking, and pottery will be explored. Repeatable with a maximum of 6 credits. (3H,3C)

#### 3954: STUDIO-STUDY ABROAD

The Europe Studio offers students the opportunity to make comparative studies of European cultures, as well as to study the relationship of culture to the physical environment, the organization of cities, and the history and behavior of their inhabitants. Exercises include analysis and documentation of elements of the physical environment, exploration of the interface between buildings and the fabric of the existing city, and examination of the professional community's reactions to urban design solutions. X-grade allowed. (\*H,6C)

#### 3974: INDEPENDENT STUDY

Variable credit course.

#### 3984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 4015-4016: ARCHITECTURE IV

Design laboratory in conjunction with alternative studies in one of the College's off-campus centers. Focus on the evaluation of skills developed in the third year professional studies and emphasis toward individualized topical areas of study leading to the development of a thesis project. X-grade allowed. Pre: 3016 for 4015; 4015 for 4016. (2H,12L,7C)

#### 4034: BUILDING CITIES

Analytical studies in the historical evolution of cities, towns and villages. Comparative studies of urban form in relation to their constructive and imaginative means with an emphasis on modern construction processes. Specific case studies in designing and building cities. Co: 4016. (3H,3C)

#### 4044 (LAR 4124): 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. (3H,3C)

#### 4055,4056: ENVIRONMENT AND BUILDING 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. (3H,3C)

#### 4075-4076: BUILDING 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: ESM 3704. (3H,3C)

#### 4114: IDEAS, CONCEPTS, AND REPRESENTATIONS OF ARCHITECTURE

Survey of ideas, concepts, and representations that have shaped architecture. Particular emphasis is given to ideational constructs and how they have been adapted in the projecting of buildings. Pre: 3016. (2H,2C)

#### 4144: ADVANCED BUILDING STRUCTURES I

Study of long-span building structures. Introduction to geometry, form, and structure of folded and bent surfaces. Study of space grid geometry, close-packing systems, and cellular tensegrity. Approximate design of folded plate structures, single and double curvature shells, single and double layer space frames, suspension roofs, tents, and pneumatic structures. Pre: 4075, 4076. (3H,3C)

#### 4154: ADVANCED BUILDING STRUCTURES II

Study of highrise structures ranging from building slabs and blocks, terraced buildings, and skyscrapers to towers. The complexity of load action including wind, earthquake, and hidden loads. The effect of building height, form, and proportion on force action; considerations of stability and redundancy. Preliminary design of masonry buildings, core structures, suspension buildings, braced skeletons, rigid frames, interstitial systems, staggered truss buildings, tubes and hybrid structures. Pre: 4075, 4076. (3H,3C)

#### 4164: COMPUTER APPLICATIONS IN DESIGN

Computer system fundamentals. Very brief introduction to assembly programming. Programming in a high level language. Construction of a simple text editor. Construction of a simple relational file. Computer graphics fundamentals. Geometric transformations. 3-space geometry and projections. (3H,3C)

#### 4204: URBAN TECHNOLOGY AND ARCHITECTURE

Architecture as determinant of urban spaces and urban form; perceptual, morphological, and typological characteristics of urban spaces as expressions of social values, ideals, and technological innovation. Theoretical models of technological, function, environmental, and social determinants of urban configurations are related to their cultural and historic precedents. X-grade allowed. (3H,3C)

#### 4214: TOPICS IN ARCHITECTURE HISTORY AND THEORY

Topics in the history of architecture and theory, predominantly with reference to the Western World. Special emphasis on methods of analysis and interpretation. Repeatable with a maximum of 9C. X-grade allowed. Pre: 3115, 3116. (3H,3C)

#### 4304: TOPICS IN DESIGN METHODS

Topics in systematic methods of design and the nature of the design process including application of creative techniques, analogous thinking, analytic methods, computer-aided procedures, and information handling in design. Repeatable with a maximum of 6 credits. X-grade allowed. (3H,3C)

#### 4414: ADVANCED ENVIRONMENT BUILDING SYSTEMS

Advanced studies of environment and building systems, including development in building systems, urban

systems, service systems, construction systems, materials and component systems, psycho-physical considerations, systems analysis, and computer technology. May be repeated for a maximum of 9 credit hours in varied options offered. X-grade allowed. Pre: 4055, 4056. (2H,3L,3C)

#### 4515-4516: ARCHITECTURE V

Advanced independent architectural research requiring articulation of a conceptual and professional position. This position is realized in a terminal thesis project completed in the second semester of the fifth year. X-grade allowed. Pre: 4016 for 4515; 4515 for 4516. 4515: (2H,20L,9C) 4516: (2H,16L,6C)

#### 4524: THESIS DOCUMENTATION

During the second semester of the fifth year, the student takes a required three hour thesis documentation course where their conceptual and professional position is defined and tested by the documentation of the terminal architectural project. Pre: 4515. Co: 4516. (3H,3C)

#### 4705-4706: QUALIFYING DESIGN SEMINAR

Exploratory overview of selected theories and issues relevant to the design and use of the environment.

4705: Emphasis on history, human behavior, and environmental context as it relates to architecture.

4706: Presentation and discussion of the nature of principal construction materials in relation to building design. Characteristics of primary structural materials: wood, steel, concrete, masonry; environmental control systems; supporting technologies. Not for credit for majors holding a first professional degree in architecture. (3H,3C)

#### 4715-4716: QUALIFYING DESIGN LABORATORY

4715: Design laboratory in which student and faculty teams explore the nature of problems and potentials with which architecture is concerned, and experimentally develop methods and process through which existing contexts are transformed into new conditions. 4716: Provides introduction to basic concepts of building structures, materials, and enclosure systems, and appropriate site and climate responses. Not for credit for majors holding a first professional degree in architecture. X-grade allowed. (3H,18L,9C)

#### 4904: PROFESSIONAL STUDIES

Pass/Fail only. X-grade allowed. (1H,1C)

#### 4944: CONSORTIUM STUDIES IN ARCH

International consortium of Schools of Architecture. Undergraduate students are provided an academic environment utilizing the Washington D.C. metropolitan area as an educational laboratory for pursuit of architecture, landscape architecture and urban design and planning. Consortium studies courses are not for credit but reflect enrollment as a full time student. Approval for participation required by student home institution and Virginia Tech. Special fees apply. (0C)

#### 4974: INDEPENDENT STUDY

Variable credit course. X-grade allowed.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Air Force ROTC

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[Scholarships](#)

[Undergraduate Course Descriptions \(AS\)](#)

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**Head:** Cameron W. Torrens, Col., USAF

**Professor:** C.W. Torrens

**Assistant Professors:** J.M. Guy, R.A. Ward, G.D. Moy, and S.C. McGan

**Unit Admissions Officer:** J.M. Guy (231-8026)

**Administrative Assistant:** Connie Moses (231-6404)

Web: [www.af.vt.edu](http://www.af.vt.edu)

## Overview

The Air Force Reserve Officer Training Corps (AFROTC) provides a program of leadership development which prepares college men and women for service as commissioned officers in the United States Air Force. After graduation, they assume active duty positions in both flying and non-flying specialties. To accomplish this, the Department of Aerospace Studies recruits, selects, retains, and commissions officer candidates as second lieutenants in the United States Air Force. AFROTC:

- Provides ethics and values education, stressing the Air Force core values of integrity first, service before self, and excellence in all we do.
- Prepares cadets to be commissioned as second lieutenants through a curriculum which develops leadership and management skills and provides opportunities to use these skills in a variety of practical applications.
- Provides an understanding of how to lead and influence small organizations, with a strong emphasis on personal integrity, honor, and individual responsibility. The techniques of effective leadership and

quality management are stressed to achieve mission accomplishment.

- Enhances the cadets' understanding of the role of the military in society and provides an in-depth orientation to history and tradition of the Air Force and how the Air Force serves the nation. This goal is reinforced by summer hands-on leadership training and career orientation opportunities at Air Force bases around the country.
- In conjunction with the Virginia Tech Corps of Cadets, provides programs and experiences which increase self-confidence, self-discipline, accountability, physical stamina, poise, and other traits essential to the development of a leader of character who is prepared to serve the nation or the commonwealth both in and out of uniform.

The curriculum and leader development programs of the Department of Aerospace Studies are mentally and physically challenging. Cadets learn basic military skills and participate in a demanding physical conditioning program starting in the freshman year. The program moves progressively from followership to leadership experiences and culminates with the senior class cadets planning, organizing, and administering all leadership training for the cadet group. On-campus instruction is conducted both in the classroom by Air Force officers and in the field environment by both officer and cadet leaders. Semiannual visits to Air Force bases expand the cadets' knowledge of Air Force operations and life-style. A demanding summer field training encampment prior to the junior year prepares the cadet for acceptance into the commissioning track.

Air Force ROTC offers four-, three-, and two-year tracks. Four- and three-year track cadets must complete 8 semester hours of AFROTC academics prior to a four-week summer encampment. The two-year track cadets complete a six-week summer encampment where they receive the freshman and sophomore academic courses in addition to the normal four-week field training course of instruction. Students who have Junior ROTC, other-service ROTC, national guard, reserve, or active duty military experience may request credit and advanced placement.

## Scholarships

Air Force ROTC offers four-, three-, and two-year scholarships which are based on merit, not need. Though scholarship awards vary, most pay all tuition, books, and approved university fees. High school seniors who are interested in the four-year or guaranteed three-year scholarships must apply at <https://www.afrotc.com> by Dec. 1 of their senior year. Non-scholarship cadets may apply for three- and two-year scholarships during their freshman and sophomore years. All students who are contracted into the AFROTC program (includes all scholarship winners and those juniors and seniors holding a commissioning contract) receive a tax-free stipend of up to \$500 per month while in school.

Virginia Tech requires membership in the Virginia Tech Corps of Cadets to be enrolled in ROTC. All freshman and sophomore cadets, as well as contracted junior and senior cadets, receive a special Air Force uniform allowance to offset the cost of cadet uniforms. The Corps of Cadets also provides need- and merit-based scholarships for deserving cadets.

Membership in the Virginia Tech Corps of Cadets and completion of four years of Air Force ROTC may qualify a student to receive a minor in leadership. The leadership progression program of the Corps of Cadets and the leadership education inherent in the AFROTC program in combination allow the student to earn this leadership minor -- an academic achievement only available at Virginia Tech. Contact the Rice Center for Leader Development, 540-231-9455, for information on how to apply for the leadership concentration.

Air Force ROTC builds leaders and offers every student who successfully completes the program a job upon graduation. The basic requirements for commissioning are: award of a degree from Virginia Tech including 24 hours of AFROTC; be a U.S. citizen of good moral character; meet medical and physical standards; achieve passing scores on the Air Force Officer Qualifying Test; and willingly accept a four-year service commitment.

# Undergraduate Course Descriptions (AS)

## 1115-1116: INTRODUCTION TO THE AIR FORCE

Introduction to the United States Air Force and Air Force Reserve Officer Training Corps. Mission and organization of the Air Force, officership and professionalism, military customs and courtesies, Air Force officer opportunities, and introduction to communication skills. Co: 2944 for 1115. (1H,1C)

## 2115-2116: THE DEVELOPMENT OF AIR POWER

Study of air power from balloons through the jet age. Historical review of air power employment. Evolution of air power concepts and doctrine. Air Force communication skills Pre: 1115, 1116. Co: 2944 for 2115. (1H,1C)

## 2934: AIR FORCE FITNESS

Reflects change in culture on physical fitness and incorporates fitness as a way of life with the United States Air Force & the Air Force Reserve Officer Training Corps (AFROTC). Structured to motivate members to develop and maintain year-round physical fitness conditioning program emphasizing total-body wellness to meet expeditionary mission requirements. Prepares cadets to tackle squadron fitness programs upon entering active duty. Course may be taken up to 10 times. Pre-requisite: Enrollment on AFROTC Co: 2944. (2H,1C)

## 2944: AFROTC LEADERSHIP LABORATORY

Experiential learning laboratory that allows cadets to practice and demonstrate mastery of leadership skills essential to an Air Force officer. May be taken eight times. Membership in Virginia Tech Corps of Cadets required. Pass/Fail only. Co: 1115, 1116, 2115, 4216, 3215, 3216, 4215, 2116. (4L,1C)

## 2974: INDEPENDENT STUDY

Variable credit course.

## 2984: SPECIAL STUDY

Variable credit course.

## 3215-3216: AIR FORCE MANAGEMENT AND LEADERSHIP

Integrated leadership study emphasizing concepts and skills. Motivational and behavioral processes, management, military ethics, communication, and group dynamics. Examines case studies and scenarios. Pre: 2116. Co: 2944 for 3215. (3H,3C)

## 4215-4216: NATIONAL SECURITY FORCES IN CONTEMPORARY AMERICAN SOCIETY

Examines the formulation, organization, and implementation of national security; evolution of strategy; management of conflict; and civil-military interaction. Military profession, officership, and the military justice system. Air Force communication skills. Pre: 3216. Co: 2944 for 4215. (3H,3C)

## 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

## 4974: INDEPENDENT STUDY

Variable credit course.

## 4984: SPECIAL STUDY

Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Agricultural Technology - Associate Degree Program

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### [Satisfactory Progress towards Degree](#)

### [Undergraduate Course Descriptions \(AT\)](#)

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**Director:** P. Mykerezi, Ph.D.

**Senior Instructors\*:** S. Doak, R. Kohl, and T. Martin

**Advanced Instructor:** J. Guthrie

**Instructor:** W. Gwaltney

**Undergraduate Program Directors:** S. Doak and R. Kohl

\* In addition, selected faculty members from departments within the College of Agriculture and Life Sciences and the Virginia-Maryland Regional College of Veterinary Medicine teach courses in the program.

## Overview

The Agricultural Technology Program offers a concentrated academic experience for individuals pursuing an associate degree in preparation for careers in the agriculture and green industries. Students can specialize in Applied Agricultural Management or Landscape and Turfgrass Management.

### **Applied Agricultural Management (AAM)**

- Animal Science
- Crop Science
- Agribusiness

The AAM specialty provides students with a balanced education â€” including courses in livestock

production, crop production, and agribusiness â€” that prepares them for diverse job opportunities.

The animal science curriculum includes courses in genetics, nutrition, reproduction, health, and management. It focuses on the biological and economic aspects of animal production and management. Soils, forages, mechanics and chemical application courses round out the AAM curriculum.

Business courses provide instruction in financial recordkeeping, professional selling, personnel management, strategic marketing, whole business planning, and information systems, focusing on strategic management and economic issues of the agricultural industry. Laboratories stress the use of modern management methods and computer applications for problem solving.

The crop science curriculum provides students knowledge and hands-on experiences relative to Virginia's major crop and forage systems. Students learn about cash crop rotations and grazing management as well as precision agriculture, integrated pest management, pesticide application, and pesticide safety. Students gain experience using the latest technologies in precision agriculture through labs held in partnership with leaders from the farm equipment industry.

### **Landscape and Turf Management (LTM)**

- Golf Course Management
- Landscape Management
- Sports Turf Management
- Horticulture Production

In the LTM speciality, students prepare for a career in the green industry â€” including landscape design, landscape contracting, golf course management, horticulture production and nursery management, and sports turf management. They learn about turfgrass and landscape installation, maintenance, and management.

The LTM curriculum focuses on developing well-rounded students who are in high demand by many branches of the green industry. Students learn about various types of plants, turfgrass management, soils and nutrient management, landscape design, Irrigation and drainage, and Spanish culture and language instruction.

Additional courses are offered in horticulture production, hardscaping, landscape contracting, golf and sports turf management, integrated pest management, and chemical application. Special study classes allow students to work on the Virginia Tech golf course and athletic fields and compete in national competitions. A strong core of business courses is also offered. Laboratories for each class focus on hands-on learning and expose students to a range of applied landscape and turf management skills.

## **Course Requirements for Major**

### **Degree Requirements**

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

All students are required to complete an occupational internship for academic credit to provide practical

experience in a work environment. The three-credit internship lasts for 10 weeks and 400 hours. The internship usually occurs during the summer between the first and second year of the program. Students, in consultation with faculty members, select their own internships that may be located anywhere in the United States or abroad.

All admission offers for this program are made through the Agricultural Technology Program. Foreign language is not a requirement of this program. Recommended high school courses include English, Algebra I and Geometry (minimum), a lab science, and a computer class. Students are encouraged to pursue an Advanced or Standard Diploma from high school. Agricultural Technology students have the same rights and privileges as other students at Virginia Tech, except for membership in the Corps of Cadets and participation in NCAA sports. Selected agricultural technology courses can be transferred to a bachelor's degree program in the College of Agriculture and Life Sciences at Virginia Tech. Bachelor degree students are not permitted to enroll in Agricultural Technology courses.

## Satisfactory Progress towards Degree

Students must achieve and maintain a cumulative 2.00 GPA each semester;

All AT courses will be used in the calculation of the GPA.

## Undergraduate Course Descriptions (AT)

### 0104: COMPUTER APPLICATIONS IN THE AGRICULTURAL INDUSTRY

Provides a basic understanding of the operation and use of the micro-computer for farm/firm business management. Stresses the practical applications of Microsoft Office (word processing, spreadsheets, and database management systems, PowerPoint, and Outlook), Adobe Acrobat including PDF Annotator, and OneNote to agricultural production and financial management decisions. (2H,3L,3C)

### 0114: APPLIED AGRICULTURE MATHEMATICS

This course will provide students with a background in the mathematical methods and operations used to solve numerical problems arising in soils, dairy, horticulture, landscape, poultry, turf, crops, livestock and feeds. Students will become acquainted with terminology and equations unique to agricultural businesses and enterprises. Emphasis is placed on solving word problems. (3H,3C)

### 0124: AGRICULTURAL MACHINERY & MECHANICS

Introduction to the operation and maintenance of internal combustion engines, field machinery, tractor and power units, and shop to include the fundamentals of gas and arc welding. (2H,3L,3C)

### 0144: COMMUNICATION SKILLS

Written and oral communication skills, including business and technical writing, public speaking, and interpersonal communication. Instruction and practice in the application of communication skills for business and agriculture. Emphasis on effective use of word processing and email software. (3H,2L,4C)

### 0164: INTRODUCTION TO ANIMAL SCIENCE

Study of animal products, production methods, and management systems for beef, sheep, horses, dairy, swine and poultry. Classroom instruction, demonstrations, and hands-on experience with livestock and poultry. (3H,3L,4C)

### 0174: FUNDAMENTALS OF TURFGRASS MANAGEMENT

Turfgrass identification, morphology, adaptations, and management systems for parks, lawns, athletic fields, roadsides, and golf courses. Mowing, irrigation, fertilization, soil management, pest management, and other practices that impact turf management. Turfgrass management planning utilizing Integrated Pest Management and Best Management Practices. (3H,3L,4C)

### 0184: INTRODUCTION TO PLANT BIOLOGY AND CHEMISTRY

Basic botanical and chemical principles and their applications to sound plant production and management practices. Emphasis on practical experiences in laboratory and field settings. (2H,2L,3C)

**0194: AT INTERNSHIP**

Practical experience in a selected agricultural enterprise, under the direct supervision of owner, manager, or supervisor. Internship will be evaluated by faculty member. Written reports of work experience activities are required. Completion of at least 28 credits with a minimum GPA of 2.00 required. Variable credit course. X-grade allowed.

**0224: PERSONNEL MANAGEMENT**

Principles and practices in the recruitment, selection, and compensation of employees. Emphasis on employer/employee relationships, including incentive programs. Impacts of safety and environmental concerns on the health and well-being of agricultural employees. (1H,2L,2C)

**0234: INTRODUCTION TO AGRIBUSINESS AND FINANCIAL MANAGEMENT**

Functions of agribusiness enterprises within the U.S. economic framework. Economic systems, cooperatives, essential elements of business organization, management tools for decision-making, creating financial statements, business planning, development and analysis of budgets, investing in a business, and time value of money. (2H,3L,3C)

**0254: ANIMAL STRUCTURES AND ENVIRONMENTS**

Functional considerations in facilities development for production agriculture. Concepts of farmstead planning and system development emphasized. Techniques for providing production animal environment, especially for confinement facilities. Pre: 0114. (3H,3C)

**0274: STRATEGIC AGRIBUSINESS MARKETING AND ENTREPRENEURSHIP**

Principles of marketing through the agribusiness industry including the strategic management of products, distribution, promotion, and pricing to improve business performance. Entrepreneurship is explored as a career alternative including methods for acquiring necessary start-up capital. Solving business problems utilizing finance and marketing tools. (2H,2L,3C)

**0284: PROFESSIONAL SELLING FOR AGRIBUSINESS**

Fundamentals of professional selling in the agricultural environment. Preparing and making sales presentations for an agricultural product. Safety and environmental concerns associated with the purchase and/or use of an agricultural product or service. (1H,2L,2C)

**0294: LIVESTOCK MERCHANDISING**

A comprehensive study of the principles and activities involved in successfully promoting and merchandising livestock. A livestock auction will be held at the conclusion of the course to provide experiences in advertising, salesmanship, facility development, sale management, and budgeting. Pre: Second year student. (2H,2C)

**0304: MEATS AND ANIMAL PRODUCTS EVALUATION AND PROCESSING**

Principles and applications of the evaluation and utilization of animal products of beef, pork, lamb, poultry and dairy origin with emphasis on the conversion of live animals to retail cuts and processed meats and milk into dairy products. (6L,2C)

**0324: LIVESTOCK REPRODUCTION**

Principles and practices of reproductive management used to maximize reproductive efficiency in dairy and beef cattle, sheep, swine, and horses. Must be second year student in Agriculture Technology. Pre: 0164. (1H,2L,2C)

**0334: PRINCIPLES OF ANIMAL HEALTH**

A general introduction to animal health principles of farm animal species, intended to provide an understanding of the fundamentals of disease processes and animal healthcare. The emphasis is on disease prevention and control rather than on the treatment of disease. Must be second year student in Agriculture Technology. (2H,3L,3C)

**0344: GRAIN CROP MANAGEMENT**

Principles and practices of efficient grain crop management with an emphasis on Virginia cropping systems. Pre: 0184, 0414. (3H,3L,4C)

#### 0354: FEEDS AND FEEDING

Principles and practices of livestock feeding. Anatomy and physiology of ruminant and non-ruminant digestive systems. Emphasis on nutrient requirements and ration formulation. Computerized ration formulation and evaluation. (1H,2L,2C)

#### 0364: ATHLETIC FIELD PRACTICUM - FOOTBALL/SOCCER

Learn the principles and techniques of game preparation and routine maintenance on the NCAA football and soccer fields at Virginia Tech. Students' laboratory experience will be field work with the Virginia Tech Athletic Department staff. Focusing the football and soccer fields during the NCAA competition season. (6L,2C)

#### 0374: ATHLETIC FIELD PRACTICUM - BASEBALL/SOFTBALL

Learning the principles and techniques of game preparation and routine maintenance on the NCAA baseball and softball fields at Virginia Tech. Students' laboratory experience will be field work with the Virginia Tech Athletic Department Staff. Focusing on the baseball and softball fields during the NCAA competition season. (6L,2C)

#### 0394: GOLF COURSE PRACTICUM

Principles and techniques of golf course preparation and maintenance required for a high-end golf course. Off-site fieldwork, laboratory experience. Practice maintenance procedures needed to rejuvenate the golf course from the summer season. Pre: 0174. (6L,2C)

#### 0404: IRRIGATION AND DRAINAGE

Principles applied to solving irrigation and drainage problems. Emphasis placed on hydraulics, irrigation design, irrigation scheduling, and components including heads, valves, controllers, backflow prevention, wire, pipe, and fittings. Co: 0114. (2H,2L,3C)

#### 0414: SOILS AND NUTRIENT MANAGEMENT

Physical, chemical, and biological properties of soils; soils' suitability for production of a range of agricultural crops to include turfgrass and landscape plants. Properties of common liming, biosolid, manure, and fertilizer materials with emphasis on their environmental impacts. Soil and plant sampling procedures and the analysis of soil tests. Nutrient management plans. (2H,2L,3C)

#### 0434: PEST MANAGEMENT: INSECTS, DISEASES, AND WEEDS

Identification, classification, and life cycles of economically important insects, plant pathogens, and weeds. Pest management methods: cultural practices, chemical control, biological control, host plant resistance, etc. (3H,3L,4C)

#### 0444: COMPUTER-AIDED DRAFTING FOR LANDSCAPING

In-depth study and hands-on experience essential to landscape horticulture graphics in a digital format using industry appropriate software. Pre: 0684. (1H,3L,2C)

#### 0464: FORAGES AND FORAGE ANIMAL SYSTEMS

use of cool-season and warm-season forage species currently grown in Virginia in forage-based animal systems. Pre: 0184, 0414. (3H,3L,4C)

#### 0494: DAIRY MANAGEMENT

Concepts of efficient and profitable management of modern dairy herds. Application of basic principles of business, milking, mastitis control, milk quality, herd replacements, feeding, breeding, reproduction, herd health, housing, and milk marketing management to profitable dairy farming. (2H,3L,3C)

#### 0504: AGRICULTURAL TECHNOLOGY SURVEY

Orientation to the Agricultural Technology program and resources available at Virginia Tech. Introduction to state, national, and international agriculture; internship requirements; and opportunities and careers in agriculture. (1H,1C)

#### 0514: CONTEMPORARY AGRICULTURAL ISSUES

A survey course designed to acquaint the student with the concerns and critical issues impacting the field of agriculture. Contemporary agricultural issues will be explored. (3H,3C)

#### 0524: WHOLE FARM PLANNING

Principles of whole farm and agricultural business planning including creating business plans, personal financial plans, and farm/business transition plans. Identifying and solving real-world agribusiness problems utilizing proper planning. Pre: 0234. (2H,2C)

#### 0544: HORTICULTURE PRODUCTION

Production of vegetable, fruit, flowering, and nursery crops, including propagation of these crops. Focus is on the culture of these commodities as alternative agricultural crops, including environmental and cultural requirements for high quality production. (2H,2L,3C)

#### 0554: CHEMICAL APPLICATION

Proper application of pesticides and other agricultural chemicals used in landscape and turf management and in production agriculture; including application methods, equipment calibration and configuration, occupational health and safety, and pesticide laws and regulations. (1H,2L,2C)

#### 0564: HERBACEOUS PLANTS

Identification, selection, requirements, and uses of herbaceous plant materials commonly found in landscapes; includes annuals, perennials, bulbs, and grasses. (1H,2L,2C)

#### 0574: WOODY LANDSCAPE PLANTS

Identification and uses of evergreen and deciduous woody plant materials common in the landscape industry; including trees, shrubs, and ground covers; proper plant selection and location in the landscape site. (1H,3L,2C)

#### 0614: BEEF AND SHEEP MANAGEMENT

Beef cattle/sheep production and management. Emphasis on genetics, nutrition, herd health, reproduction, and marketing to optimize performance and profit. Management and flock decisions based on economic and business principles. Practical experience enhanced through laboratory activities. (2H,3L,3C)

#### 0624: HORSE MANAGEMENT

Horse production and management. Emphasis on genetics, nutrition, herd health, reproduction, and marketing to optimize performance and profit. Management decisions based on economic and business principles. Practical experience enhanced through laboratory activities. (2H,3L,3C)

#### 0654: GOLF COURSE DESIGN AND RULES

Principles of golf course design and rules of the game, including: evolution, fairness, progression, hazards, shot value, and safety. The United States Golf Association's rules of golf will be covered. (2H,2C)

#### 0664: GOLF AND SPORTS TURF MANAGEMENT

Management of turfgrass on modified soil. Advanced management techniques and manipulation of nutrition and cultural practices to reduce plant stress or increase plant tolerance. Intensive turfgrass pest identification, life cycles, environmental conditions, and methods of effective control. Integrated pest management and best management practices. Pre: 0174, 0414. (2H,2L,3C)

#### 0674: SPANISH FOR THE GREEN INDUSTRY

Dialogue-based language skills focused on vocabulary and grammatical structures common to agricultural and green industries. Includes vocabulary and contexts specific to activities in greenhouse, nursery, turf, and landscape environments. Elements of Spanish culture are included throughout the course. Pre: Prior study in Spanish is helpful but not required. (3H,3C)

#### 0684: LANDSCAPE DESIGN

Principles and practices involved in the development and interpretation of landscape designs; proper selection and use of landscape construction materials and methods of construction. Introduction to utilizing computer-aided drafting. Pre: 0564. Co: 0574. (2H,3L,3C)

#### 0694: LANDSCAPE CONTRACTING

Interpreting a landscape design and properly installing plant materials. Preparing bids for customers using cost accounting principles. Maintaining and renovating landscapes as well as exploring careers and business opportunities in the landscaping industry. Pre: 0564, 0574. (2H,3L,3C)

#### 0704: TURFGRASS CAPSTONE PROJECT

Capstone course for the Landscape Turfgrass Management option of the Agricultural Technology program. Problem based learning course to evaluate selected turfgrass problems for stakeholders such as golf courses, athletic fields and parks and recreation departments' facility administrators. Students to look holistically at a problem and use critical thinking, experiences and knowledge from previous class work to create custom solutions. For second-year students only. (1H,4L,3C)

#### 0714: HARDSCAPE MATERIALS AND INSTALLATION

Non-plant portions of landscape construction such as rock walls, paver floors, arbors, and water gardens. The course covers the materials, construction. Restricted to students in the Landscape & Turf Management option in the Agricultural Technology Program. (6L,2C)

#### 0724: LANDSCAPE SKILLS PRACTICUM

This course provide an introduction to a multitude of skills that are important for success in the landscape industry. Each session is set in a competitive environment emphasizing the development of a selection of hands-on skills, including safe equipment operation, landscape and hardscape installation, management and estimating techniques, and arboculture methods. (2L,1C)

#### 0734: RISK MANAGEMENT IN AGRICULTURE

Fundamentals of managing risk in agriculture, particularly for production of row crops and livestock, including sources of risk and cost/benefit analysis of various risk mitigation strategies. Commodity futures contracts and options as price risk management tools. Government policies, particularly crop and livestock insurance provisions of the current Farm Bill. Co: 0234. (2H,2C)

#### 0904H: HONORS SEMINAR IN AGRICULTURAL TECHNOLOGY

Exploration of topics in agriculture and related fields that impact and effective and efficient agricultural industry, including professional leadership skills. Special attention will be given to the collaboration and interdependency that the field of agriculture has with other segments of society, including social, political, and economics areas. May be repeated for a maximum of 3 credits and with different topics. (1H,1C)

#### 0974: INDEPENDENT STUDY

Variable credit course.

#### 0984: SPECIAL STUDY

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Building Construction

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[Degree Requirements](#)

[Undergraduate Course Descriptions \(BC\)](#)

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**Head:** Y.J. Beliveau

**William E. Jamerson Professor:** W.Y. Thabet

**Professors:** Y.J. Beliveau and W.Y. Thabet

**Associate Professors:** A.P. McCoy, T. H. Mills, A.R. Pearce, and G. Reichard

**Assistant Professor:** T. Bulbul

Web: [www.bc.vt.edu](http://www.bc.vt.edu)

## Overview

The Building Construction curriculum focuses on the business and process of making buildings and is designed to better equip construction industry professionals with the necessary tools for excellence in all phases of the built environment. The building construction degree incorporates business, management, science and efficiency at all levels; from planning, finance, design, estimating, procurement, and scheduling. The curriculum additionally includes integrative elements of leadership, non-technical social and presentation skills, entrepreneurship, and best principles.

The Building Construction program develops within the student a solid foundation in construction knowledge.

The Building Construction major is accredited by the American Council for Construction Education. Upon successful completion of the four-year program of 134 credit hours of study, a Bachelor of Science in Building Construction is awarded.



# Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Undergraduate Course Descriptions (BC)

### 1214: INTRODUCTION TO BUILDING CONSTRUCTION I

This is an introduction to the world of construction with an overview of the important areas of contracting and the inter-workings of the construction industry. Emphasis is placed on the theory and terminology of the construction industry supplemented with the graphical representation of construction documents and laboratory building experiments. (2H,3L,3C)

### 1224: INTRODUCTION TO BUILDING CONSTRUCTION II

Continuation of introduction to the world of construction with an overview of the important areas of contracting and the workings of the construction industry. Emphasis is placed on the application of theory, processes and vocabulary of the construction industry supplemented with computer aided graphical representation of construction documents. Grade of C- or better required in prerequisite. Pre: 1214. (2H,3L,3C)

### 2014: CONSTRUCTION PRINCIPLES I

This course covers the fundamentals of construction technology and processes emphasizing materials, methods, techniques and sequences for the construction of buildings (CSI Divisions 1-6). Planning, scheduling and quantity surveying for the management of construction resources are among the topics studied. Pre: 1224. Co: MATH 1225. (2H,3L,3C)

### 2024: CONSTRUCTION PRINCIPLES II

This is a continuation of the fundamentals of construction technology and processes emphasizing materials, methods, techniques and sequences for the construction of buildings in CSI divisions 7-16. Planning, scheduling, quantity surveying and control systems for the management of these construction resources are among the topics studied. Pre: 1224, 1214, 2014. Co: 2064. (3H,3C)

### 2034 (REAL 2034): REAL ESTATE DATA ANALYSIS

Real estate market data and the statistical tools for analyzing data to support decision making. Descriptive statistics and hypothesis testing. Form insights to inform management and investment decisions. Pre: UAP 2004 or REAL 2004. (2H,2C)

### 2044: BUILDINGS & MATERIALS

Introduction to the theory and applications of building materials. Properties, composition, and characteristics of building materials with particular focus on ferrous and non ferrous metals, concrete, bricks and blocks, timber, glass and plastics. Emphasis on physical behavior of materials under load, including thermal loads, compatibility deformations and material behavior requirements, interaction among different materials, non-destructive/destructive methods for evaluation and testing of construction materials, basic analysis and design applications of major structural components. Pre: 2214 or CNST 2104. (2H,3L,3C)

### 2064: CONSTRUCTION PRINCIPLES INTEGRATED LAB

Develop a competency in applying construction means and methods as they relate to quantity take-off, cost management, scheduling and resource management in support of a senior capstone project. Co: ARCH 3045, 2024, CEE 3014. (1H,2L,2C)

#### 2094: BUILDING CONSTRUCTION SEMINAR

Exploration of current and relevant topics of inquiry within the construction domain, through engagement, service, and research. Articulates the complex interactions of stakeholders in construction by means of reflection on case studies, panel discussions, and seminars to establish the context, breadth, and impact that construction education shares within larger academic, professional, and societal communities. Can be repeated for a maximum of 3 credit hours. Pass/Fail only. (1H,1C)

#### 2104: BUILDING EFFECTIVE CONSTRUCTION TEAMS

Introduction to tools and techniques to help build effective construction teams including building trust, managing conflict, communicating clear expectations and priorities, accountability, attention to results and commitment towards construction management team mission, embracing innovative change and ethics. Other topics include networking skills, time management tools and effective construction team-based negotiations. Pre: 1224, (COMM 1016 or ENGL 1106). (3H,3C)

#### 2114: INFORMATION TECHNOLOGY IN DESIGN AND CONSTRUCTION

Building delivery and project management improvements through the use of computer applications are explored, including scheduling software, building information modeling (BIM) tools, and virtual design and construction (VDC) simulation software and their corresponding theories and concepts the integrate design and construction. Pre: 1224 or CNST 2104. Co: 2014. (2H,3L,3C)

#### 2214: WHY BUILDINGS STAND UP

Addresses why structures remain stable under various loading conditions. Explores different types of structures and applied loads and analyzes both determinate and indeterminate supported structures. Explores different types of soils and their strength properties. Pre: MATH 1225 or MATH 1025. (3H,3C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3014: BUILDING PHYSICS & ENVIRONMENTAL SYSTEMS

Theory and analysis methods relative to performance of envelope systems and the design and integration of mechanical and electrical building systems. Topics covered include: envelope systems and performance metrics, conceptual and technical design theory, operational principles, and maintenance issues, all necessary for determining the selection of passive and active environmental control systems within a building including: envelope system, heating, active environmental control systems within a building including: envelope system, heating, ventilation, air conditioning, lighting, and acoustical systems. Pre: PHYS 2305. (2H,3L,3C)

#### 3064: BUILDING SYSTEMS TECHNOLOGY LAB

Develop a competency in the application of Building Environmental Systems, through modeling, scheduling, estimating, and experiments in support of a senior capstone project. Co: BC 4004 or CEE 3014. Pre: (2064, PHYS 2305) or (CNST 2104, PHYS 2305). Co: 3114. (1H,2L,2C)

#### 3114: BUILDING SYSTEMS TECHNOLOGY

Emphasis is placed on the integration and physical installation of passive and active environmental control systems including: heating, ventilation, air conditioning, lighting, acoustics, plumbing, and fundamentals of thermal loads. Pre: (2024 or CNST 2104), PHYS 2305. Co: 3064. (2H,3L,3C)

#### 3134 (CNST 3134): TEMPORARY STRUCTURES IN CONSTRUCTION

Introduction to temporary structure systems used to support construction operations. Concrete formwork, scaffolding systems, excavation shoring systems, dewatering techniques, and hoisting operations. Assessment of systems, cost, quality, safety, sustainability, and schedule impacts. Pre: (2044 or CEE 3684), (BC 2024 or CEE 3014). (3H,3C)

#### 3954: STUDY ABROAD

Study abroad in Spain. Variable credit course.

#### 4024 (CEE 4014): ESTIMATING, PRODUCTION, AND COST ENGINEERING

Interpretation of plans and specifications, preparation of construction estimates, and cost control. Methods analysis, resource requirements, and resource costs in building systems, including system components, and in large-scale civil engineering works such as highways, bridges, and hydraulic structures. Pre: 2024, 2064. (3H,3C)

#### 4064: CONSTRUCTION PRACTICE LAB

Application of the business and construction practices related to operation of a construction company to the execution of a senior capstone project. All project management concepts learned in prior courses are applied in the capstone lab experience. Written and oral work is formally presented and critiqued among construction faculty, students, and industry professionals. Pre: 3064. Co: 4434. (1H,2L,2C)

#### 4114: BUILDING INFORMATION MODELING IN DESIGN AND CONSTRUCTION

Introduction to means and methods to enrich the geometric information of a building model with semantic data such as, material, structural and performance values. Concept of interoperability in architecture, engineering and construction industry. Overview of approaches to information modeling such as Standard for the Exchange of Product model data (STEP), Industry Foundation Classes (ifc), Construction Operations Building Information Exchange (COBie) and Green Building XML (gbXML). Key concepts of object-oriented modeling and programming. Pre: 2114. (3H,3C)

#### 4124: DIGITAL CONSTRUCTION & MANUFACTURING

Explore and experiment with construction from the perspective of digital information, computer numerical control (CNC), and computer aided manufacturing (CAM) processes. Tools like 3D scanners, 3D printers, CNC manufacturing techniques and others will be used in a lab setting intended to provide familiarity with these technologies and a sense of their benefits and limitations. Pre: 2114. (2H,3L,3C)

#### 4164: PRODUCTION PLANNING AND PROCESS DESIGN FOR CONSTRUCTION

The course deals with the planning and design of construction processes. Course topics include production systems, behavior of construction systems and workers, the relationships between subsystems in the construction process, queuing systems, process modeling and simulation. The major emphasis is on production and productivity. Production problems that typically occur in construction systems are discussed. The course also explores recent innovations in construction system design such as lean construction and agile construction. Pre: 3114, 3064. (3H,3C)

#### 4314: BUILDING PERFORMANCE & ENERGY MANAGEMENT

Fundamentals of building performance mandates for the built environment, practical means and methods for evaluating building performance metrics. Specific focus on energy resources consumed by thermal, hygrothermal, lighting, and other environmental building systems. Assessment of building energy consumption and analysis of retrofit scenarios through performance evaluation over the entire building life cycle. Pre: 3014. (2H,3L,3C)

#### 4334: SUSTAINABLE BUILDING PERFORMANCE MANAGEMENT

Introduction to means and methods for managing the sustainability of buildings and their performance over the life cycle. Best practices for sustainable projects in the areas of planning/development, site design, project management, energy and water conservation and green building assessment tools and methods; Leadership in Energy and Environmental Design (LEED) rating system; economic analysis of green building alternatives; and implementation planning. Pre: 3064. (3H,3C)

#### 4434: CONSTRUCTION PRACTICE I

Business and construction practices related to operation of a construction company are studied. Construction operation is examined as it relates construction, financial and personnel management. Project management topics studied in this course include permitting, site evaluations, design development and design phase considerations such as preliminary estimates and project constructability. Writing Intensive (WI) course. Pre: (2044 or CEE 3014). Co: 4064. (3H,3C)

**4444: CONSTRUCTION PRACTICE II**

This course explores and applies the business and construction practices related to operation of a construction company to a capstone experience. Construction operation is examined as it relates to construction, financial and personnel management. Project management topics studied in this course are applied in the corequisite lab. This course is formally designated as a writing intensive course. Formal written and edited and oral presentations are presented and critiqued by the BC faculty team, the writing resource center, students and industry professionals. Pre: 4434. (3H,3L,4C)

**4754: INTERNSHIP**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Biochemistry

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[Undergraduate Course Descriptions \(BCHM\)](#)

**Head:** P. J. Kennelly

**Professors:** D. R. Bevan, D. R. Dean, G. E. Gillaspay, P. J. Kennelly, T. J. Larson, J. Li, and Z. Tu

**Associate Professors:** R. F. Helm, M. W. Klemba, B. Mukhopadhyay, P. Sobrado, R. H. White, and J. Zhu

**Assistant Professors:** M. B. Cassera, Z. B. Mackey, D. Slade, and B. Xu

**Adjunct Faculty:** B. Costa, C. Finkelstein, D. Good, D. Kelly, and J. Mahaney

**Career Advisor:** P. J. Kennelly (231-6315) [pjkennel@vt.edu](mailto:pjkennel@vt.edu)

**Undergraduate Coordinators:** D. R. Bevan (231-5040) [drbevan@vt.edu](mailto:drbevan@vt.edu) and T. J. Larson (231-7060) [tilarson@vt.edu](mailto:tilarson@vt.edu)

Web: [www.biochem.vt.edu](http://www.biochem.vt.edu)

## Overview

The Bachelor of Science in biochemistry is designed to provide students with a thorough foundation in chemistry and biology and an appreciation of how these sciences are integrated to explore the molecular mechanisms underlying biological processes. The plan of study prepares students for careers in medicine, veterinary medicine, biomedical research, agriculture, industrial biochemistry, or biotechnology. In addition, it provides the background for post-graduate studies in the life sciences or professional studies in medicine, nursing, veterinary medicine, dentistry, pharmacy, and clinical chemistry.

The department offers the undergraduate biochemistry degree in two colleges, the College of Agriculture

and Life Sciences and the College of Science. Biochemistry majors complete the Curriculum for Liberal Education requirements unique to the college in which they are enrolled.

The departmental requirements for majors in either college are: mathematics (9-12 credits); physics (8 credits); principles of biology (8 credits); genetics (3 credits); general microbiology (4 credits); general chemistry (8 credits); organic chemistry (8 credits); physical chemistry (6 credits); analytical chemistry (4 credits); introduction to biochemistry (1 credit); biochemical calculations (2 credits); general biochemistry (7 credits); and laboratory problems in biochemistry and molecular biology (6 credits).

To qualify for a major in biochemistry, the department requires that students maintain a minimum 2.0 grade point average (GPA) for the hours passed in all required biochemistry, biology, and chemistry courses. In addition, the department requires that a student earn a C- or better in all required biochemistry, chemistry, and biology courses.

The plan of study allows time for qualified students to participate in undergraduate research (BCHM 4994). Qualified students are strongly encouraged to initiate research activity prior to their senior year. A minimum GPA of 2.5 is required for enrollment in BCHM 4994. Students participating in undergraduate research are encouraged to present a senior thesis.

Upper-division students who qualify for the Honors Program may participate in the "in honors" degree program in biochemistry. The Honors Program and undergraduate research program include study and research with individual faculty members.

Biochemistry majors may participate in the Cooperative Education Program that alternates academic study with employment experience. Additional information pertaining to the CO-OP program is included in the "General Information" section of this catalog. Summer internships with various businesses and governmental agencies are frequently available, particularly to rising seniors.

## Bioinformatics/Genomics

The department supports students' interest in bioinformatics/genomics by providing instruction and laboratory experience in those areas. Students are advised of appropriate supporting courses in computer science that may be used toward a minor in Computer Science.

The department also offers a graduate program leading to the M.S. and Ph.D.

The minimum number of credits required for the B.S. in Biochemistry is 120.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Biochemistry.

Satisfactory progress requirements toward the B.S. in Biochemistry in both the College of Agriculture and Life Sciences and in the College of Science can be found on their major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (BCHM)

### 1014: BIOCHEMISTRY FIRST YEAR EXPERIENCE

Applications of biochemistry in agricultural and life science disciplines; topical research areas in biochemistry; educational requirements and career opportunities for biochemistry majors; critical thinking and data interpretation in biochemistry. Pass/Fail only. (1H,1C)

### 2024: CONCEPTS OF BIOCHEMISTRY

Short course in fundamentals of the chemistry of living systems. Introduction to major categories of

biochemical substances, metabolic pathways, and principles of biochemical information transfer. (No credit for majors). Pre: CHEM 2514 or CHEM 2535. (3H,3C)

#### 2114: BIOCHEMICAL CALCULATIONS

Fundamental mathematical relationships in biochemistry. Calculations central to the investigation of biochemical phenomena including aqueous chemistry, spectrophotometry, enzyme kinetics and thermodynamics. Introduction to the core calculations used in experimental biochemistry and the strategies employed for solving biochemical problems. Pre: CHEM 2535 or CHEM 2565. (2H,2C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3114: BIOCHEMISTRY FOR BIOTECHNOLOGY AND THE LIFE SCIENCES

Survey presentation of the basic principles of biochemistry as they apply to biotechnology. Topics covered include protein structure, enzymology, cellular organization, and biochemical regulation. Special emphasis will be given to gene structure, transcription, and translation, cellular organization, and cloning, sequencing, modification and expression of recombinant DNA. Examples will be given of agricultural/medical/industrial applications of cellular and molecular biochemical knowledge. Non-majors only. Pre: CHEM 2536 or CHEM 2566. (3H,3C)

#### 4034 (BMVS 4034): ENVIRONMENTAL HEALTH TOXICOLOGY

Health effects associated with the exposure to chemicals, identifying and managing problems of chemical exposure in work places and the environment, fundamental principles of biopharmaceutics and toxicokinetics, and risk assessment. Emphasis on conceptual understanding of chemical entry into the body, biotransformation, multiple chemical sensitivity, and chemically induced diseases. Identification of nutrient interactions with environmentally induced disorders and to understand the mechanisms of such interactions and their influence on human health and welfare. Pre: BIOL 2104 or BIOL 3124, ALS 2304, BIOL 2406 or BCHM 3114 or BCHM 4115, BCHM 4116. (3H,3C)

#### 4054 (APSC 4054): GENOMICS

A 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. Pre: 3114 or 4116 or BIOL 3774. (3H,3C)

#### 4074: CAREER ORIENTATION

Examination of various career opportunities for biochemists in industry, academia, medicine and related health sciences. Introduction to resources for locating career opportunities, resume preparation and interview skills. Restricted to biochemistry majors. Junior standing required. I Pass/Fail only. Co: 4115. (1H,1C)

#### 4115-4116: GENERAL BIOCHEMISTRY

Metabolism and chemistry of carbohydrates, proteins, lipids, and nucleic acids with emphasis on interactions and comparative aspects of microbial, plant, and animal forms. For students in the biochemistry curriculum and other students interested in a foundation course. (Students are required to have at least a C- in both CHEM 2535 and 2536 to be admitted to BCHM 4115). Pre: (CHEM 2535 or CHEM 2565), (CHEM 2536 or CHEM 2566), BCHM 2114 for 4115; 4115 for 4116. 4115: (4H,4C) 4116: (3H,3C)

#### 4124: LABORATORY PROBLEMS IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

Presentation of major analytical techniques of importance to biochemistry and molecular biology, including spectrophotometry, electrophoresis, chromatography. Lab study of selected principles and methods used in biochemistry and molecular biology. Pre: 4115, (CHEM 2114, CHEM 2124) or (CHEM

3114, CHEM 3124). Co: 4116. (3H,9L,6C)

4754: INTERNSHIP

Variable credit course.

4784 (BIOL 4784): APPLICATIONS IN MOLECULAR LIFE SCIENCE

Synthesis and application of biochemistry, cell biology, genetics, genomics, physiology, immunology concepts and techniques to address medical and agricultural problems. Gene characterization and manipulation, protein-based drugs, diagnostics, vaccines, transgenic plants/animals. Analysis, critique, application of research in molecular life science. Pre: (3114, 3124, BIOL 3774, BIOL 4774) or (BCHM 4116, BCHM 4124). (3H,3C)

4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Biological Sciences

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**Head:** Brenda S. J. Winkel

**Distinguished Professor:** J. J. Tyson

**Harold H. Bailey Endowed Chair:** J. R. Walters

**Professors:** L. K. Belden, E. F. Benfield, J. O. Falkinham, M. J. Friedlander, K. W. Hilu, R. Jensen, L. Li, I. T. Moore, E. T. Nilsen, B. D. Opell, D. L. Popham, J. Phillips, J. Sible, and A. M. Stevens

**Associate Professors:** J. Barrett, D. Capelluto, D. Cimini, C. Finkielstein, M. Fox, D. Hawley, C. B. Lawrence, I. Lazar, S. B. Melville, B. Scharf, F. Schubot, D. Tholl, R. A. Walker, and Z. Yang

**Assistant Professors:** B. Brown, C. Carey, S. Hauf, E. R. Hotchkiss, C. N. Jones, D. Kelly, S. Kojima, J. W. McGlothlin, M. C. Mims, K. Mukherjee, M. S. Strickland, J. Smyth, G. Valdez, and S. R. Whitehead

**Instructors:** L. A. Blanc, J. Evans, E. P. Hogan, M. V. Lipscomb, M. S. Rosenzweig, R. W. Seyler, and J. G. Tokuhisa

**Adjunct Instructional Professors:** R. G. Benoit and B. J. Turner

Web: [www.biol.vt.edu](http://www.biol.vt.edu)

## Overview

The Department of Biological Sciences offers two B.S. degree paths: the B.S. in Biological Sciences and

the B.S. in Microbiology.

The B.S. in Biological Sciences program provides majors with a broad education in the study of life. This curriculum exposes students to the fundamentals of the discipline: genetics, cell and molecular biology, evolutionary biology, and ecology. In addition, Biological Sciences majors may take advantage of elective courses on topics such as macromolecular structure, pathogenic bacteriology, cancer biology, infectious disease ecology, human genetics, and global change ecology.

The B.S. in Microbiology program provides majors with a more focused education in the biology and roles of microscopic life forms present in our environments. The laboratory-intensive curriculum provides knowledge in the genetics and physiology common to all microbes and allows students to explore specific interests with a broad range of advanced electives such as pathogenic bacteriology, immunology, environmental microbiology, food microbiology, virology, microbial forensics, and bioinformatics.

Modern biology increasingly relies on knowledge, skills, and perspectives associated with other scientific fields, particularly chemistry, mathematics, physics and statistics. Success in biological sciences-associated careers requires students to master the fundamentals of these cognate fields and to be able to apply these skill sets.

As a scientific discipline, biology is more than simple knowledge about living organisms. By integrating education and research, our majors are training to be leaders in their field who practice innovative and interdisciplinary approaches in biological research. By participating in undergraduate research during the academic year, our students are discovering through hands-on experience what it means to Invent the Future. Our majors are strongly encouraged to explore internships and research opportunities on campus and elsewhere during the summer.

The majority of our graduates continue on to advanced studies in the health professions or in various branches of the biological sciences. Graduates pursue professional degrees in medicine, dentistry, veterinary medicine, pharmacy, and nursing, or M.S. or Ph.D. degrees in ecology, environmental biology, microbiology, botany, zoology, cell biology, molecular biology, and biomedical sciences. Students interested in entering the workforce are provided the core background for opportunities in biotechnology, food science, bioinformatics, bio-business, and health-related industries.

## Preparation for Advanced Study

### Graduate Study

Students who satisfactorily complete the undergraduate curriculum in biological sciences or microbiology may pursue advanced studies leading to the M.S. or Ph.D. in various branches of the biological sciences.

### Preparation for Medicine

The training afforded by the first three years (approximately 96 hours) meets the pre-medical training requirements of medical colleges that accept students with only three years of undergraduate work. It is strongly recommended, however, that all students complete a B.S. before entering medical school.

### Preparation for Dentistry

Dental colleges require a minimum of three years of college training for admission, but it is generally advisable for students to complete the B.S. before entering dental school.

### Preparation for Allied Health Professions

Schools of Allied Health Professions, such as nursing, pharmacy, medical technology, physical therapy, etc., require two or more years of college work for admission. Specific requirements are available from Career Services or the Biological Sciences Department.

### Preparation for Veterinary Medicine

Veterinary schools require a minimum of three years of college training for admission. Few students who meet only the minimum entrance requirements are accepted by veterinary schools.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Minor Requirements

The requirements to earn a minor in Biology can be found on its checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Biological Sciences and the B.S. in Microbiology can be found on their major checksheets by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (BIOL)

### 1004: BIOLOGY ORIENTATION SEMINAR

An introduction to academic and career planning for majors in Biology and students who may be considering Biology as a major. (1H,1C)

### 1005,1006: GENERAL BIOLOGY

Primarily for those not majoring in the life sciences. General principles of biology and their relevance to society. 1005: Cell function and physiology, nutrition, circulation and water balance in plants and animals, hormones, nerves. 1006: Muscles, behavior, genetics, development, populations, evolution, ecology and the life kingdoms. (Duplicates 1105, 1106). (3H,3C)

### 1015,1016: GENERAL BIOLOGY LAB

Primarily for students not majoring in the life sciences. Laboratory experiments emphasizing observation and experimental procedures to investigate biological processes and phenomena. 1015: Cell biology and genetics. 1016: Plant, animal and environmental biology. (Duplicates 1115, 1116; 1125, 1126). (2L,1C)

### 1105,1106: PRINCIPLES OF BIOLOGY

For students majoring in the life sciences. 1105: biological molecules, cell structure, metabolism, and reproduction; Mendelian and molecular genetics. 1106: animal and plant anatomy and physiology, ecology, and animal behavior. (Duplicates 1005, 1006). Co: 1115 for 1105; 1116 for 1106. (3H,3C)

### 1115,1116: PRINCIPLES OF BIOLOGY LABORATORY

Emphasizes biological principles through investigative exercises and collaborative learning. 1115: cell chemistry, physiology and reproduction and genetics; 1116: plant and animal form and function, and ecology. Primarily for students majoring in the life sciences. (Duplicates 1015 1016, 1125, 1126). X-grade allowed. Co: 1105 for 1115; 1106 for 1116. (3L,1C)

#### 1125,1126: BIOLOGICAL PRINCIPLES LAB

Emphasizes biological principles through experimental design and collaborative learning. 1125: cell chemistry, physiology and reproduction, genetics and evolution. 1126: plant and animal form and function, and ecology. This writing intensive course is part of the Writing Across the Major option; these two laboratory courses plus three additional designated Biology courses will fulfill the Area I Writing Intensive requirement for Biology majors. Primarily for students majoring in Biology. (Duplicates 1015, 1016, 1115, 1116). Co: 1106, 1105 for 1125. (3L,1C)

#### 1135-1136: PHAGE HUNTERS

Isolation, identification, and characterization of bacteriophages from environmental sources. 1135: Bacteriophage DNA purification, genomic analysis, imaging, and sequencing. 1136: Bioinformatic characterization and annotation of sequenced bacteriophage genomes, comparative genomic analysis, submission of bacteriophage sequence data to public databases. (6L,2C)

#### 1205H,1206H: HONORS BIOLOGY

Emphasizes biological principles through investigative exercises and collaborative learning. 1205H: cell chemistry and structure, energy transformations, genetics and microevolution. 1206H: macroevolution, plant and animal physiology, populations, ecology and behavior. This is a writing intensive course. Simultaneous enrollment in laboratory required. For students who qualify for the University Honors Program. (Duplicates 1005, 1006; 1105,1106). (3H,3L,4C)

#### 2004: GENETICS

Mendelian transmission, chromosome behavior and organization, gene and chromosome mutation, genetic properties of nucleic acids, gene expression and development, DNA technology. X-grade allowed. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H), (CHEM 1036 or CHEM 1056 or CHE M 1036H or CHEM 1056H or CHEM 1016). (3H,3C)

#### 2104: CELL AND MOLECULAR BIOLOGY

Fundamental molecular mechanisms essential for the function of prokaryotic and eukaryotic cells. Topics will include: organization and maintenance of cellular structure, energy production, transcriptional regulation, protein synthesis, regulatory pathways, cell-cell interactions and reproduction. Pre: (1005 or 1105 or 1205H), (1106 or 1206H or 1006), (CHEM 1036 or CHEM 1056 or CHEM 1016 or CHEM 1036H or CHEM 1056H). (3H,3C)

#### 2124: CELL AND MOLECULAR BIOLOGY FOR ENGINEERS

Composition, structure and function of cells; fundamentals of gene expressions, cell physiology, cellular movement and reproduction; stem cells and tissue formation; synthetic biology and applied cell and molecular biology. Not for Biological Sciences majors. Pre: ENGR 2164 or COS 2164. (2H,2C)

#### 2204: PLANTS AND CIVILIZATION

The uses of plants as sources of food, medicine, drugs, spices, beverages, poisons, fiber, oils, and plant exudates. Pre: (1005, 1006) or (1105, 1106) or (1205H, 1206H). (3H,3C)

#### 2304 (HORT 2304): PLANT BIOLOGY

Introductory botany. Form, growth, function, reproduction, and ecological adaptations of major groups of plants. Pre: (1005, 1006) or (1105, 1106) or (1205H, 1206H). (3H,3C)

#### 2404 (ALS 2404): BIOTECHNOLOGY IN A GLOBAL SOCIETY

Introduction to the world-wide impact of biotechnology and molecular biology, including applications to plants, animals, and microorganisms. Explores basic concepts of genetic engineering, scientific and ethical issues, and public concerns related to biotechnology. Topics include: environmental release of genetically engineering organisms, bioremediation, safety of genetically engineered food products, transgenic plants and animals, gene therapy, and genetic screening. Pre: (1005, 1006) or (1105, 1106) or

(1205H, 1206H), CHEM 1015, CHEM 1016. (3H,3C)

**2504: GENERAL ZOOLOGY**

Morphology, features, adaptations, and ecology of major animal groups, emphasizing major patterns of evolutionary change. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (3H,3C)

**2604: GENERAL MICROBIOLOGY**

Microbial structure, function, metabolism, genetics and ecology. The role of microorganisms in host/parasite relationships will be emphasized. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H), (CHEM 1036 or CHEM 1056 or CHEM 1036H or CHEM 1056H or CHEM 1016). (3H,3C)

**2604H: HONORS GENERAL MICROBIOLOGY**

Microbial structure, function, metabolism, genetics and ecology. The role of microorganisms in host/parasite relationships will be emphasized. Additional written assignments, class discussions, and readings from the primary literature will be required. Pre: (1005, 1006) or (1105, 1106) or (1205H, 1206H), (CHEM 1015, CHEM 1016) or (CHEM 1035, CHEM 1036). (3H,3C)

**2614: GENERAL MICROBIOLOGY LABORATORY**

Introduction to microbiological techniques and procedures. Course requirements may be satisfied by taking BIOL 2604 prior to or concurrent with course. Co: 2604. (3L,1C)

**2704: EVOLUTIONARY BIOLOGY**

Evolutionary mechanisms, systematic principles, and theories of the origin and evolution of life. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (3H,3C)

**2704H: EVOLUTIONARY BIOLOGY**

Evolutionary mechanisms, systematic principles, and theories of the origin and evolution of life. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (3H,3C)

**2804: ECOLOGY**

Fundamental interaction of organisms with the biotic and abiotic components of ecosystems. Topics will include: physical environment and organismic interactions, concepts of population ecology and community ecology, ecosystems interactions, and environmental problems. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (3H,3C)

**2804H: HONORS ECOLOGY**

Fundamental interaction of organisms with the biotic and abiotic components of ecosystems. Topics will include: physical environment and organismic interactions, concepts of population ecology and community ecology, ecosystems interactions, and environmental problems. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (3H,3C)

**2964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Honors section. Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**2994: UNDERGRADUATE RESEARCH**

Variable credit course. X-grade allowed.

**2994H: UNDERGRADUATE RESEARCH**

Variable credit course. X-grade allowed.

#### 3014 (ENT 3014): INSECT BIOLOGY

Insect biology provides an introduction to the science of entomology. The course covers the diversity of insects, their biology and behavior, the importance of insects and insect control programs in agriculture, and the effects that insects have had on human history and culture. Laboratory (3024) is optional. Pre: (1005, 1006) or (1105, 1106) or (1205H, 1206H). (2H,2C)

#### 3024 (ENT 3024): INSECT BIOLOGY LABORATORY

Taxonomy and ecology of insects commonly encountered. Identification of all orders and many common families. Ecological attributes of each taxon, including food, habitat, life cycle, and behavior. An insect collection is required. Pre: (1005, 1006) or (1105, 1106) or (1205H, 1206H). Co: 3014. (1H,3L,2C)

#### 3104: CELL AND MOLECULAR BIOLOGY LABORATORY

Introduction to methods used to study prokaryotic and eukaryotic cells. Recombinant DNA, protein expression and purification, the polymerase chain reaction, bioinformatics, and microscopy. Pre: 2104. (3L,1C)

#### 3114: FIELD AND LABORATORY ECOLOGY

Experimental and field studies of population growth, competition, stressed ecosystems, plant distribution, and other interactions of plants, animals and microbes with their environments. Several required weekend field trips. Pre: 2804 or 2804H. (3L,1C)

#### 3124: CELL PHYSIOLOGY

Cell structure and metabolism, including enzymes, energy production, photosynthesis, membranes, nerve conduction, muscle contraction, and regulation of cellular activity. Pre: 2104, CHEM 2536. (3H,3C)

#### 3134: HUMAN GENETICS

Principles of genetic analysis in humans with emphasis on genetic diseases of humans; methods of karyotyping human chromosomes; methods of pedigree and genetic analysis of humans; principles, techniques, and analysis of twin studies in humans; techniques used to identify and characterize normal and abnormal chromosomes; principles and methods of DNA fingerprint analysis of humans. Pre: 2004 or 2104. (3H,3C)

#### 3204: PLANT TAXONOMY

Systematic survey of vascular plants, emphasizing identification, terminology, classification, evolutionary relationships. X-grade allowed. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (2H,3L,3C)

#### 3254 (ENT 3254): MEDICAL AND VETERINARY ENTOMOLOGY

An introduction to the roles of insects and other arthropods in the direct causation of disease in humans and animals, and as vectors in the transmission of disease organisms. The epidemiology and replication cycles of vector-borne pathogens with major medical and veterinary importance will be examined. Information will be provided on the biology and behavior of disease vectors and external parasites, and on the annoying and venomous pests of humans and animals. Mechanisms of control will be discussed. Pre: (1005, 1006) or (1105, 1106) or (1205H, 1206H). (3H,3C)

#### 3264 (ENT 3264): MEDICAL AND VETERINARY ENTOMOLOGY LABORATORY

Taxonomy and anatomy of insects and arthropods of medical and veterinary importance. Examination of feeding behavior and ecology. Emphasis on the mechanism of injury or pathogen transmission by each group. Pre: (1105, 1106) or (1005, 1006) or (1205H, 1206H). Co: 3254. (3L,1C)

#### 3404: INTRODUCTORY ANIMAL PHYSIOLOGY

A comparative systems level approach to the physiology of animals, emphasizing vertebrates: metabolic, temperature, osmotic, and ionic regulation; function of respiratory, circulatory, digestive, muscle, nervous, and locomotory systems; endocrine regulation and biological rhythms. Must have prerequisites or instructor's permission. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (3H,3C)

#### 3454: INTRODUCTORY PARASITOLOGY

Ecology, taxonomy, morphology, life cycles, pathogenesis, and host-parasite relationships of parasitic eukaryotes. Pre: (1005 or 1105 or 1205H), (1006 or 1106 or 1206H). (3H,3L,4C)

#### 3504: HEALTH PROFESSIONS PRECEPTORSHIP

Cooperative shadowing experience in conjunction with select regional hospitals and local health provider. Students observe various medical or dental specialties under the supervision of health professionals. Selection by Director, Office of Health Professionals Advising, and prehealth advisors. Approval by health faculty and mentor required. Pre: junior standing; minimum overall GPA of 3.3. Pass/Fail only. Pre: 1105, 1106, CHEM 1036. (6L,2C)

#### 3514: INTRODUCTION TO HISTOLOGY

Overview of tissue structure and function in the human body; microscopic examination of tissue sections; organization of tissues in different organ systems; histopathology of tissues and organs. Pre: 2104. (2H,3L,3C)

#### 3604 (FST 3604): FOOD MICROBIOLOGY

Role of microorganisms in foodborne illness, food quality, spoilage, and preservation. Control of microorganisms in foods. Methods to enumerate, identify, and characterize microorganisms in foods. Pre: 2604, 2614. (3H,3L,4C)

#### 3774: MOLECULAR BIOLOGY

Advanced study of the molecular biology of prokaryotic and eukaryotic cells, including mechanisms of gene expression and regulation, relative merits of experimental model systems, and practical applications in agriculture and medicine. Pre: 2104 or ALS 3104. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4004: FRESHWATER ECOLOGY

Interactions of physical, chemical, and biological properties of freshwater ecosystems. Pre: 2804. (3H,3L,4C)

#### 4014: ENVIRONMENTAL TOXICOLOGY

Discussion of ecotoxicological and philosophical issues in the development of standards for control of toxic chemicals in freshwater, including site-specific examples, application of current control methods, recovery of damaged ecosystems, and government regulations. Pre: 2804. (2H,2C)

#### 4104: 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. Pre: 2004. (3H,3C)

#### 4114: GLOBAL CHANGE ECOLOGY

Effects of human alteration of climate, landscapes and biogeochemical cycling on ecological structure and functioning at the global scale. Influence of global changes on ecosystem processes and biodiversity with paleo- and contemporary examples. Current and future potential feedbacks between biological systems and the global environment. Pre: 2704, 2804. (3H,3C)

#### 4134: EVOLUTIONARY GENETICS

Genetic variation, Hardy-Weinberg equilibrium, agents of change in gene frequencies, molecular evolution, mechanisms of speciation. Comparison of theoretical models with natural and laboratory populations. Pre: 2004, 2704. (3H,3C)

#### 4164 (CSES 4164) (ENSC 4164): ENVIRONMENTAL MICROBIOLOGY

Ecology, physiology, and diversity of soil and aquatic microorganisms; incorporates the significance of these topics within the context of environmental applications such as bioremediation, wastewater treatment, control of plant- pathogens in agriculture, and pollution abatement in natural systems. The laboratory portion of the course will stress methodology development, isolation and characterization of microorganisms from natural and engineered systems, and examination of the roles of microorganisms in biogeochemical cycling. Pre: 2604. (2H,3L,3C)

#### 4314: PLANT ECOLOGY

Introduction to ecology of terrestrial plants including major plant functional types, ecophysiological aspects of functional types, molecular plant ecology, behavior of populations, responses of plant communities to disturbance, and vegetation analysis. Laboratory covers methods for measuring and analyzing natural vegetation, and setting up field and greenhouse experiments. Pre: (2304 or 2804 or FOR 3314) or HORT 2304. (3H,3L,4C)

#### 4334: CHEMICAL ECOLOGY

Chemical interactions between organisms with emphasis on the plant biosphere. Fundamental concepts, theories, and general methodology of chemical ecology: mechanisms of chemically-mediated interactions; and engineering of natural chemical defenses in sustainable agriculture. Pre: (2304 or 2804 or FOR 2314 or BCHM 4115), CHEM 1035. (3H,3C)

#### 4354 (ENT 4354): AQUATIC ENTOMOLOGY

Biology and taxonomy of insects and other macroinvertebrates most commonly encountered in freshwater environments. Selected aspects of biology, such as habitat, feeding, locomotion, and life history. Identification of individual taxa, mostly at family and genus level. Significance of these organisms in aquatic ecology, pollution monitoring, and natural resource management. Pre: (1005, 1006), (1015, 1016) or (1105, 1106, 1115, 1116). (3H,3L,4C)

#### 4404: ORNITHOLOGY

Biology of birds, including functional anatomy, systematics, evolutionary history, behavior, and ecology. Laboratory on systematics, anatomy, and field experience in the areas of behavior and ecology. Pre: 2804. (3H,3L,4C)

#### 4454: INVERTEBRATE ZOOLOGY

Identification, morphology, evolutionary relationships, and natural history of free-living invertebrates, excluding insects. Pre: 2504. (3H,3L,4C)

#### 4474: ETHOLOGY

An evolutionary and ecological approach to animal behavior, drawing on behavioral genetics, endocrinology, neurophysiology, and behavioral ecology to explain how and why the behavior of an organism is adapted to its environment. Pre: 2504. (3H,3C)

#### 4484 (ENT 4484) (FIW 4484): FRESHWATER BIOMONITORING

Concepts and practices of using macroinvertebrates and fish to monitor the environmental health of freshwater ecosystems. Effects of different types of pollution and environmental stress on assemblages of organisms and underlying ecological principles. Role of biological studies in environmental regulation. Study design, field and laboratory methods, data analysis and interpretation, verbal and written presentation of results. Pre: (2804), (4004 or 4354 or ENT 4354 or FIW 4424 or FIW 4614). (3H,3L,4C)

#### 4554 (ALS 4554): NEUROCHEMICAL REGULATION

Neurochemical transmission within the vertebrate brain will be examined. Emphasis will be placed on the chemical coding underlying the control of various behaviors and how these systems can be modified by various drugs or diet. Pre: (ALS 2304 or BIOL 3404), (CHEM 2535). (3H,3C)

#### 4564: INFECTIOUS DISEASE ECOLOGY

Principles of infectious disease dynamics from ecological and evolutionary perspectives. Examines a variety of wildlife hosts and disease-causing agents (bacteria, viruses, and parasites) using the framework of agent-host-environment interactions. Selective coverage of specific host and pathogen models to illustrate underlying principles of wildlife disease emergence, maintenance, and spread, as well as connections between wildlife and human health. Pre: 2704, 2804. (3H,3C)

#### 4574 (ALS 4574): SOCIAL BEHAVIOR OF BIRDS AND MAMMALS

This course examines origins, influences and implications of social behavior in a variety of avian and mammalian species. Emphasis is placed on understanding group organization and dynamics in inter and intra-species situations. Experimental data from several disciplines (e.g., genetics, physiology, biochemistry) are reviewed to demonstrate their associations with behavioral adaptive mechanisms. Avian and mammalian species living in wild, zoo, agricultural companion and laboratory settings are discussed.



Pre: 1106, ALS 3104 or BIOL 2004. (3H,3C)

#### 4624: MICROBIAL GENETICS

Molecular genetics of bacteria and their associated plasmids and phages. Pre: 2004, (2604 or 2604H). (3H,3C)

#### 4634: MICROBIAL PHYSIOLOGY

The study of the structure, function and metabolic activities of prokaryotic microorganisms. Topics covered included cell composition and growth, metabolic unity and diversity, patterns of regulation, transport mechanisms, environmental sensing and response and cellular differentiation processes. (BIOL 4624 is recommended, but not required.) Pre: (2604 or 2604H), (2104 or 2004). (3H,3C)

#### 4644: MICROBIAL MOLECULAR GENETICS AND PHYSIOLOGY LABORATORY

Introduction to classical and molecular methods used for the study of bacterial genetics and physiology. Laboratory exercises cover analysis of patterns of gene regulation; assay of enzymatic activities; mutagenesis followed by selection, screening, and physiological characterization of mutant strains; genome database utilization; and large scale fermentation. Pre: 4624. (1H,6L,3C)

#### 4664: VIROLOGY

Classification, structure, pathogenesis, host response, and replication strategies of viruses of bacteria, plants, and animals, stressing mechanisms elucidated by molecular biological techniques. Pre: 2104, (2604 or 2604H), 2614. (3H,3C)

#### 4674: PATHOGENIC BACTERIOLOGY

Characteristics of bacteria that cause human disease, nature of infectious processes, virulence factors, epidemiology, resistance, immunization. Pre: 2004, 2104, (2604 or 2604H), 2614. (3H,3C)

#### 4704: IMMUNOLOGY

Immunochemistry of antigens and antibodies, serological reactions, chemistry of complement, control of immunity, immune response of an intact animal. Pre: 2104, (CHEM 2536 or CHEM 2566). (3H,3C)

#### 4714: IMMUNOLOGY LABORATORY

Serological and immunobiological techniques used to interpret the consequences of an immune response. Pre: 2104, (CHEM 2536 or CHEM 2566). Co: 4704. (3L,1C)

#### 4724: PATHOGENIC BACTERIOLOGY LAB

Microbiological techniques used in the laboratory to identify and characterize bacteria that cause infectious diseases. Pre: 2004, 2104, (2604 or 2604H), 2614. Co: 4674. (3L,1C)

#### 4734: INFLAMMATION BIOLOGY

Cellular and molecular pathways controlling human responses to inflammatory challenges. Regulation of immune cells during inflammation. Interaction of host cells and tissues with environmental risk factors that cause inflammation. Pathogenesis of inflammatory diseases including cardiovascular diseases, diabetes, multi-organ failure, aging, neurological diseases and sepsis. Therapeutic intervention of inflammatory diseases. Pre: 2104. (3H,3C)

#### 4764: MICROBIOLOGY SENIOR SEMINAR

Review and discussion of contemporary research topics in microbiology and immunology, methods of research data analysis, the research publication process, research presentation and interview skills, career paths for microbiology and immunology graduates, preparation for graduate school, preparation for entry into the job market. Pass/Fail only. Co: 4624. (2H,2C)

#### 4774: MOLECULAR BIOLOGY LAB

An introduction to recombinant DNA methods, including restriction endonuclease digestion, gel electrophoresis, cloning, Southern blotting, polymerase chain reaction, sequencing and analysis of reporter gene expression in transgenic organisms. BIOL 3774 may be taken as a corequisite with 4774. Pre: 3774. (1H,6L,3C)

#### 4804: PROKARYOTIC DIVERSITY

The study of the vast array of physiological, morphological, and behavioral properties of prokaryotes. Topics include: modern prokaryotic classification, prokaryotic diversity, relationship and importance to cell and molecular biology and biochemistry, application and use in industry and agriculture, and to the maintenance of the biosphere. Must have pre-requisites or consent of the instructor. Pre: (2604 or 2604H), 2614, (3124 or 4634 or BCHM 3114). (3H,3C)

#### 4824: BIOINFORMATICS METHODS

Application of bioinformatics methods in biological research. Methods to access bioinformatics data. Theory and methods for analysis of DNA sequences, and analysis of complex data sets including whole genome sequences and gene expression data. Use of standard bioinformatics software and databases. Pre: 2004, 2104. (2H,3L,3C)

#### 4834: PRACTICAL ANALYSIS OF PROTEIN STRUCTURE AND FUNCTION

Application of biophysical and biomechanical methods to characterization of protein structure and function, macromolecular interactions and conformational changes. Strategies, experimental design, practical considerations, troubleshooting, data analysis. Pre: 2104, (CHEM 2536 or CHEM 2566), (PHYS 2206 or PHYS 2306). (2H,3L,3C)

#### 4844: PROTEOMICS AND BIOLOGICAL MASS SPECTROMETRY

Introduction to mass spectrometry (MS) instrumentation and advanced proteomic methods for systems biology applications. Peptide mass fingerprinting, tandem MS, quantitation, phospho/glyco proteomics, and bioinformatics tools for evaluation and interpretation of mass spectrometry data. Pre: 2104, CHEM 2536, PHYS 2205, PHYS 2206. (3H,3C)

#### 4854: CYTOGENETICS

Structure and function of eukaryotic chromosomes, with emphasis on (i) use of model systems to study specific chromosome substructures or functions; (ii) techniques used to identify and classify both normal and aberrant chromosomes; and (iii) diseases caused by defective chromosome structure and/or function. Pre: 2004, 2104. (3H,3C)

#### 4874: CANCER BIOLOGY

The molecular and cellular basis of cancer, including viral and cellular oncogenes, tumor suppression mechanics, cellular immortality, genomic integrity, angiogenesis, metastasis, and traditional and developing theories. Pre: 2004, 2104. (3H,3C)

#### 4884: CELL BIOLOGY

Advanced study of the inner workings of eukaryotic cells, including membrane structure and function, protein secretion, the cytoskeleton, cell cycle control and intercellular communication. Pre: 3774 or BCHM 4116. (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course. X-grade allowed.

#### 4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Business Information Technology

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**Head:** B. W. Taylor III

**Andersen Professor of Management Science:** L. P. Rees

**Bank of America Professor:** C.T. Ragsdale

**R. B. Pamplin Professors of Management Science:** B. W. Taylor III and C. W. Zobel

**Houchens Professor of Management Science:** T. R. Rakes

**Ralph Medinger Lenz Professor in Business:** R. D. Badinelli

**Richard E. Sorensen Dean's Chair:** R. T. Sumichrast

**Verizon Professor in Management Science:** D. F. Cook

**Professors:** P. Ghandforoush and R. S. Russell

**Associate Professors:** A. S. Abrahams, J.K. Deane, B. J. Hoopes, T. L. James, L. Z. Khansa, R. L. Major, L. A. Matheson, Q. J. Nottingham, O. Seref, and G. Wang

**Assistant Professors:** M.M.H. Seref

**Advanced Instructors:** L.L. Clark and R.M. Jones

**Instructors:** J.M. Teets

**Career Advisor:** B. W. Taylor III (540-231-6596)

Web: [www.bit.vt.edu](http://www.bit.vt.edu)



## Overview

The Department of Business Information Technology offers an undergraduate major in business information technology with options in computer-based decision support systems and operations and supply chain management. The department also offers and staffs business courses, including: quantitative models and methods in business, operations and supply chain management, and computer modeling and simulation in business. Business Information Technology (BIT) courses are listed below.

The department participates in the Cooperative Education Program in which qualified students may alternate semesters of study with semesters of professional employment.

## Business Information Technology

The curriculum in business information technology is designed to provide the student with expertise in the quantitative and technological aspects of management, specifically including the extensive use of computers for solving business problems and making managerial decisions. The name business information technology implies the application of scientific principles and techniques, mathematics, and computing to the management function with the objective of increased efficiency and productivity. Thus, the student of business information technology not only learns various quantitative techniques and models to apply to managerial problems, but also a logical and scientific approach to managerial decision-making. The curriculum provides training both for individuals interested in pursuing careers in business management and for individuals interested in pursuing graduate or professional degrees. Students majoring in business information technology may choose one of two options reflecting their particular career objectives and interests.

### Option I - Computer-Based Decision Support Systems

This option educates the student in the design, implementation, and use of computerized information systems, decision support systems, and expert systems which support contemporary business managers in the decision-making process. Special emphasis is placed on increased productivity through the use of models, quantitative data, and techniques in the computerized decision support system. Training in Option I will enable graduates of this program to pursue careers in business and industry in which computer-aided decision-making is an essential component of the managerial function.

## Option II - Operations and Supply Chain Management

This option educates students in the management of activities directly related to the creation and distribution of goods and services. The curriculum of Option II is designed to provide 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 improve the quality and productivity of business firms and their supply chain partners. Graduates of this program will be prepared to pursue careers as operations managers, business process analysts, quality assurance specialists, supply chain specialists, and quality control, logistics, inventory and procurement managers in business, industry, and government.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Undergraduate Course Descriptions (BIT)

### 2405,2406: QUANTITATIVE METHODS

Study of quantitative techniques used in managerial decision-making. BIT 2405: Data collection, descriptive statistics, probability theory, and statistical inferential procedures. BIT 2406: Linear regression and correlation analysis, forecasting, mathematical modeling, and network models. Pre: (MATH 1525, MATH 1526) or (MATH 1205, MATH 1526) or (MATH 1225, MATH 1526) or (MATH 1016, MATH 1526) or (MATH 1525, MATH 2015, MATH 1114) or (MATH 1016, MATH 2015, MATH 1114) or (MATH 1015, MATH 1525, MATH 2015) or (MATH 1015, MATH 1525, MATH 1206) or (MATH 1015, MATH 1205, MATH 2015) or (MATH 1525, MATH 1206, MATH 1114) or (MATH 1016, MATH 1206, MATH 1114) or (MATH 1205, MATH 1526) or (MATH 1225, MATH 1526) or (MATH 1016, MATH 1526) or (MATH 1025, MATH 1526) or (MATH 1205, MATH 1206, MATH 1114) or (MATH 1205, MATH 1206, MATH 2114) or (MATH 1225, MATH 1226, MATH 1114) or (MATH 1225, MATH 1226, MATH 2114) or (MATH 1525, MATH 1206, MATH 1114) or (MATH 1525, MATH 1206, MATH 2114) or (MATH 1525, MATH 1226, MATH 1114) or (MATH 1525, MATH 1226, MATH 2114) or (MATH 1016, MATH 1206, MATH 1114) or (MATH 1016, MATH 1206, MATH 1114) or (MATH 1016, MATH 1206, MATH 2114) or (MATH 1016, MATH 1226, MATH 1114) or (MATH 1016, MATH 1226, MATH 2114) or (MATH 1025, MATH 1206, MATH 1114) or (MATH 1025, MATH 1206, MATH 2114) or (MATH 1025, MATH 1226, MATH 1114) or (MATH 1025, MATH 1226, MATH 2114) for 2405; 2405 or STAT 3005, (MATH 1525, MATH 1526) or (MATH 1205, MATH 1526) or (MATH 1225, MATH 1526) or (MATH 1016, MATH 1526) or (MATH 1025, MATH 1526) or (MATH 1205, MATH 1206, MATH 1114) or (MATH 1205, MATH 1206, MATH 2114) or (MATH 1225, MATH 1226, MATH 1114) or (MATH 1225, MATH 1226, MATH 2114) or (MATH 1525, MATH 1206, MATH 1114) or (MATH 1525, MATH 1206, MATH 2114) or (MATH 1525, MATH 1226, MATH 1114) or (MATH 1525, MATH 1226, MATH 2114) or (MATH 1016, MATH 1206, MATH 1114) or (MATH 1016, MATH 1206, MATH 2114) or (MATH 1016, MATH 1226, MATH 1114) or (MATH 1016, MATH 1226, MATH 2114) or (MATH 1025, MATH 1206, MATH 1114) or (MATH 1025, MATH 1206, MATH 2114) or (MATH 1025, MATH 1226, MATH 1114) or (MATH 1025, MATH 1226, MATH 2114) for 2406. (3H,3C)

### 2954: BUSINESS STUDY ABROAD

This course provides students with an international business experience. It is only offered as part of a program outside of the United States. Students will learn from the structured educational experience developed by the faculty leader. This course is intended for students who want to develop information technology or operations management related free electives. Pre: Instructor's consent and the completion of 24 semester hours with a minimum GPA of 3.0 or departmental consent. Variable credit course.

#### 3414: OPERATIONS AND SUPPLY CHAIN MANAGEMENT

Study of the process directly related to the creation and distribution of goods and services. Increasingly, these operations are taking place outside the boundaries of a traditional enterprise. This course teaches students how to analyze processes, ensure quality, create value, and manage the flow of information, products and services across a network of customers, enterprises and supply chain partners. Pre: 2406, ACIS 2116, ECON 2006. (3H,3C)

#### 3424: INTRODUCTION TO BUSINESS ANALYTICS MODELING

Introduction of modeling of problems encountered in business analytics. Statistical and optimization modeling, computer solution, and analysis of business problems. Uses spreadsheet and database software to facilitate the modeling and solution of these problems. Pre: 2406 or CS 1054 or CS 1114 or CS 1124 or CS 1705. (3H,3C)

#### 3434: ADVANCED MODELING FOR BUSINESS ANALYTICS

Study of selected, advanced topics in decision modeling and business analytics. Emphasis on model formulation, solution techniques, interpretation of results and comprehensive approaches to problem-solving. Integer, multi-criteria, and non-linear programming as well as network analysis and heuristics. Includes case studies and use of Excel as the primary analytical tool. Pre: 3424. (3H,3C)

#### 3444: ADVANCED BUSINESS COMPUTING AND APPLICATIONS

Study of selected advanced topics in business computing. Construction of business applications using an advanced application development environment such as Visual Studio.net. Coverage of computer terminology, HTML, and Internet applications. The course builds computer literacy and strong programming skills. Junior standing required. Pre: 3424, CS 1054. (3H,3C)

#### 3454: BUSINESS PROCESS IMPROVEMENT

Examines the technical aspects of business process improvement focusing on improvement strategies, quality control, data analysis and mining, and maturity models. Emphasizes analytical techniques for business process design, control, and improvement. Pre: 3414. (3H,3C)

#### 3464: ENTERPRISE PLANNING AND CONTROL SYSTEMS

The study of the design, analysis and implementation of enterprise-wide resource planning and control systems. The course examines decision support models for production planning, master scheduling, inventory control, shop floor control and related topics in planning and control. The course emphasizes the application of information technologies such as ERP, MRPII, CIM to operations planning and control. Pre: 3414. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4424: BUSINESS INFORMATION VISUALIZATION AND ANALYTICS

Basic perception and design principles and techniques for information visualization, with an emphasis on the application of visualization software for data exploration and the development of analytical skills for business. Includes hands-on exposure to information visualization and statistical software. Pre: 2406. (3H,3C)

#### 4434: COMPUTER SIMULATION IN BUSINESS

In-depth study of the application of computer simulation techniques to business decision making and process improvement. The theory of computer simulation and statistical analysis of results are included. Attention is focused on using simulation software stressing application to specific problems. Pre: 2406. (3H,3C)

#### 4444: WEB-BASED DECISION SUPPORT SYSTEMS

Study of current technologies for designing and constructing interactive, Internet-based systems for supporting business decisions. Topics may include the operation of the Internet, server-side programming, client-side programming, server-side scripting, XML, XHTML, database integration, COM, CGI, and others. Design issues will be explored through a class project. Pre: 3444. (3H,3C)

#### 4454: BUSINESS ANALYSIS SEMINAR IN IT

Comprehensive treatment of Decision Support Systems (DSS) as managerial tools, particularly in an e-commerce environment. Emphasis is at the builder and user level. A primary emphasis is on problem solving through the integration of various quantitative techniques as well as on IT concepts. The course includes a comprehensive project using state-of-the-art software. Pre: 3434, 4444, 4514. (3H,3C)

#### 4464: ADVANCED SUPPLY CHAIN MANAGEMENT

Advanced study of efficient methods for streamlining the production and delivery of products and services across functions, enterprises and global boundaries. Topics include the facilities, functions, technologies, and activities involved in creating and delivering products and services, especially in a digital marketplace. Designing and managing a network of suppliers across enterprises is discussed, along with the information systems, risk management and planning issues involved. Pre: 3414. (3H,3C)

#### 4474: GLOBAL 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. Pre: 3414. (3H,3C)

#### 4484: PROJECT MANAGEMENT

Study of efficient methods for planning and controlling projects. Topics include project management and scheduling tools, project quality assurance, risk and cost control, resource constrained scheduling, definition and requirements analysis, task integration, and managing alliances. The application of information technology to project management and control is emphasized throughout the course. Pre: 3414. (3H,3C)

#### 4514: DATABASE TECHNOLOGY FOR BUSINESS

Study of the design of databases and data structures for supporting business. Topics include basic database structure and design, structured query language, database management systems, integration of backend database servers, data warehousing and mining, on-line analytical processing, and database application, security, and management. Pre: 3424, 4524. (3H,3C)

#### 4524: SYSTEMS DEVELOPMENT

Study of the current technologies for designing and developing computer-based business systems. Topics will include process, logic, and conceptual data modeling methodologies such as Uniform Modeling Language (UML) and important design-related issues such as data flows and system capabilities. Design issues will be explored through class projects. Pre: 2406. (3H,3C)

#### 4534: VISUAL INTERFACE DESIGN FOR DECISION SUPPORT

Study of the design of visual user interfaces for computerized decision support systems in a business context. Primary emphasis is upon the Windows desktop development environment, but emerging trends in hardware and software affecting interface design are covered as well. Course includes several interface design projects implementing the concepts learned. Pre: 3444 or ACIS 2504. (3H,3C)

#### 4544: ADVANCED METHODS IN BUSINESS ANALYTICS

Study of key methods in business analytics and their role in decision making in the business context. Emphasizes data systems and methods for extracting knowledge from these systems. Business intelligence, data mining and data classification, text mining and web mining, data warehousing, geographic information systems, artificial intelligence, heuristics, and semantics and ontologies. Pre: 3444 or ACIS 2504. (3H,3C)

#### 4554 (ACIS 4554): NETWORKS AND TELECOMMUNICATIONS IN BUSINESS

This course provides an in-depth introduction to computer networks and data communications in business. Topics include mechanisms for reliable data transfer, local and wide area network topologies and technologies, and a comprehensive treatment of internetworking. The benefits, costs, and security issues related to using computer networks are discussed, along with network design issues, and methodologies for network applications. One semester of college-level programming experience required. Pre: 3424 or ACIS 3515 or ACIS 3504. (3H,3C)

#### 4564 (ACIS 4564): OBJECT-ORIENTED SYSTEMS DEVELOPMENT FOR BUSINESS

The course first develops the foundations and principles of object-oriented programming, including encapsulation, inheritance, polymorphism, and abstraction. These concepts are acquired via comprehensive hands-on experience with a current OOP language (such as Java). The second portion of the course applies concepts learned to a business-oriented application, such as a web-based, e-commerce scenario. Pre: CS 1054, (ACIS 3515 or BIT 3444). (3H,3C)

#### 4574: ADVANCED NETWORKING FOR BUSINESS

Study of advanced concepts and techniques for distributed computer networking and data communications in business. Topics may include new developments in both wired and wireless networking technologies, network planning and design, network security, and network management and disaster planning. Pre: 4554 or ACIS 4554. (3H,3C)

#### 4594 (ACIS 4594): ELECTRONIC COMMERCE SYSTEMS

Study of the design and implementation of computer systems on the Internet and world-wide-web used for electronic commerce. Emphasis of the course will be on understanding the numerous issues involved in using the Internet and web as tools for the production and distribution of goods and services. Topics will include basics of electronic commerce, security issues in financial and sensitive data transfer, unique aspects of business-oriented commerce such as supply-chain management in relation to consumer commerce, legal and international issues in electronic commerce, building and maintaining an electronic commerce website, and future trends in electronic commerce. Pre: 3414. (3H,3C)

#### 4614: INFORMATION SECURITY

Study of policies, procedures, and technologies for enhancing the security of information. Topics include physical security, communications security, emissions security, computer security, and network security. The core security goals of confidentiality, integrity, and availability are emphasized throughout the course. Pre: 4554 or ACIS 4554. (3H,3C)

#### 4954: STUDY ABROAD

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Biological Systems Engineering

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### Overview

#### [Undergraduate Course Descriptions \(BSE\)](#)

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**Head:** M. L. Wolfe

**Professors:** B. L. Benham, R. D. Grisso, W. C. Hession, K. Mallikarjunan, S. Mostaghimi, M. L. Wolfe, C. Zhang, and Y. Zhang

**Associate Professors:** J. Arogo Ogejo, J. R. Barone, C. D. Heatwole, D.J. Sample, D. Scott, R.S. Senger, and T. M. Thompson

**Assistant Professors:** Z. M. Easton, X. Feng, L.-A. H. Krometis, J. E. Shortridge, and V. R. Sridhar

**Instructor:** S. C. Mariger

Web: [www.bse.vt.edu](http://www.bse.vt.edu)

## Overview

The mission of the Department of Biological Systems Engineering (BSE) is to develop and disseminate engineering knowledge and practices that protect natural resources and improve sustainable production, processing, and utilization of biological materials.

The teaching program in BSE offers engineering B.S., M.S., and Ph.D. programs for students enrolled in the College of Engineering and service courses for students enrolled in the College of Agriculture and Life Sciences and other colleges. The degree programs in BSE are administered by the College of Engineering; therefore, the curriculum and courses offered for the B.S. in biological systems engineering are listed in the College of Engineering section of this catalog. Students interested in pursuing an undergraduate degree program in Biological Systems Engineering must first be admitted to the College of Engineering.

Service courses designed to meet the needs of students enrolled in different programs in CALS are listed in the following section. These courses generally are not taken to meet engineering degree requirements except as free electives.

## Undergraduate Course Descriptions (BSE)

### 2004: INTRODUCTION TO BIOLOGICAL SYSTEMS ENGINEERING

Introduction to the fundamental concepts of Biological Systems Engineering, including statistics, heat and mass balances, protein separation, microbial metabolism, and enzyme kinetics. Engineering design process, engineering problem-solving tools and techniques, development of oral and written communication skills, and the importance of teamwork and ethics in Biological Systems Engineering. Pre: ENGE 1024 or ENGE 1215. (1H,3L,2C)

### 2094: INTRODUCTION TO METAL FABRICATION

Introduction to metal working tools, equipment, and processes. Fundamentals of gas and arc welding. (3L,1C)

### 2294: ANIMAL STRUCTURES AND ENVIRONMENT

Functional considerations in facilities development for production agriculture. Concepts of farmstead planning and system development emphasized. Techniques for providing production animal environment, especially for confinement facilities. Pre: (MATH 1016 or MATH 1025). (3H,3C)

### 2304: LANDSCAPE MEASUREMENTS AND MODELING

Introduction to land surveying, computer-aided design, and drafting for land and water resources engineering. Representation of features in two and three dimensions for documentation and visualization of watershed engineering projects. Create plans, cross sections, detail drawings, and three dimensional visualizations using computer-aided design and drafting tools. Pre: (MATH 1206 or MATH 1226). (2H,3L,3C)

### 2484: ENGINE AND POWER TRAIN TECHNOLOGY

Fundamentals of the construction and operation of current internal combustion power units. Control of power utilizing clutches, transmissions, drive shafts, and differentials. Pre: (MATH 1016 or MATH 1025). (2H,3L,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3134: BIOLOGICAL SYSTEMS ENGINEERING SEMINAR

Critical review of technical and professional articles on current topics in Biological Systems Engineering. Development of oral presentation and technical writing skills. Contemporary ethical, professional, and global issues in Biological Systems Engineering. Pre: 2004. (2L,1C)

### 3144: ENGINEERING ANALYSIS FOR BIOLOGICAL SYSTEMS USING NUMERICAL METHODS

Solving engineering problems related to biological systems using numerical analysis including root finding, numerical integration, differentiation, interpolation and numerical solution of ordinary differential equations. Error analysis and programming with engineering software. Course requirements may be satisfied by taking MATH 2214 prior to or concurrent with course. Co: MATH 2214. (2H,2C)

### 3154: THERMODYNAMICS OF BIOLOGICAL SYSTEMS

Fundamental concepts, first and second laws, psychrometrics applied to plant and animal environments, introduction to Gibbs energy, and application of calorimetry to gain basic understanding of energy flow in a biological system. Course requirements may be satisfied by taking CEE 3304 or CHE 3114 or ESM 3234 or ESM 3024 or ME 3404 prior to or concurrent with course. Pre: ESM 2304, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). (3H,3C)

#### 3324: SMALL WATERSHED HYDROLOGY

Precipitation, soil physics, infiltration, evapotranspiration, groundwater hydrology, overland flow, open channel flow, flow routing, hydraulic analysis. Course requirements may be satisfied by taking CEE 3304 or CHE 3114 or ESM 3234 or ESM 3024 or ME 3404 prior to or concurrent with course. (3H,3C)

#### 3334: NONPOINT SOURCE POLLUTION ASSESSMENT AND CONTROL

Erosion prediction and control; transport and fate of sediment, nutrients, and microorganisms; design of nutrient management plans, wetlands, detention facilities and other management practices for rural and urban nonpoint source pollution control. Pre: 3324. (2H,3L,3C)

#### 3494: ADVANCED WELDING TECHNOLOGY

Techniques in welding that include gas, submerged metal arc, metal inert gas, pulsed arc, and tungsten inert gas welding. Design of welding structures, fundamentals of heat treatment, and plasma arc cutting. Consent required. (3L,1C)

#### 3504: TRANSPORT PROCESSES IN BIOLOGICAL SYSTEMS

Introduction to material and energy balances in biological systems. Fundamentals of heat and mass transfer in biological systems. One and two dimensional conduction, convection, and diffusion of thermal energy and mass. Heat and mass transfer rates, steady and unsteady state conduction, convection, diffusion; design of simple heat exchangers. Application of these topics and fluid mechanics to fluid handling, bacterial growth, plant nutrient uptake, enzymatic reactions. Pre: 3154, ESM 3024. (3H,3C)

#### 3524: UNIT OPERATIONS IN BIOLOGICAL SYSTEMS ENGINEERING

Unit operations for processing biological materials including heat exchangers, evaporation, drying, mixing, homogenization, extrusion, phase and multi-phase separation, and size reduction. Laboratory hands-on experience in various unit operations. Course requirements may be satisfied by taking BSE 3504 prior to or concurrent with course. Co: 3504. (2H,3L,3C)

#### 3534: BIOPROCESS ENGINEERING

Engineering concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals. Metabolic pathways leading to products, enzyme kinetics, cell growth kinetics, and analysis of bioreactors and fermenters. Co: 3504, (BIOL 2604 or BIOL 2604H). Pre: 3154. Co: BIOL 2604, 3504. (3H,3C)

#### 4125-4126: COMPREHENSIVE DESIGN PROJECT

4125: Identify and develop an engineering design project using the team approach; use of literature resources to define project objectives and approach; present project proposal in a professional written and oral manner; engineering ethics, professionalism and contemporary issues. Pre: Completion of 96 hours, overall GPA of 2.0 or better. 4126: Complete a comprehensive design project using the team approach, test approach, test prototype, and prepare and present a professional engineering design report. Pre: 3334 or 3524 for 4125; 4125 for 4126. 4125: (1H,3L,2C) 4126: (1H,6L,3C)

#### 4204: INSTRUMENTATION FOR BIOLOGICAL SYSTEMS

Introduction to instrumentation and sensors for measurement and control of biological systems. Sensor response dynamics, data acquisition, sensor selection, signal processing and signal conditioning principles. Experimental determination of velocity, pressure, strain, displacement, forces and chemical constituents. Data analysis focused on uncertainty, error and statistical concepts. Pre: PHYS 2306, ESM 3024. (2H,2L,3C)

#### 4224: FIELD METHODS IN HYDROLOGY

Site characterization: surveying, channel and floodplain mapping, land use, electronic data acquisition. Techniques for measuring surface and subsurface hydrologic processes: water flow, hydrologic conductivity, precipitation, evaporation. Sampling techniques: surface water, groundwater, and soil pore water sampling. In-situ monitoring: automatic samplers, dataloggers, water quality sondes. Laboratory analyses: good laboratory practices, selection of analytical method, calibration, quality assurance/quality control. Co: 3324 or CEE 3314 or FOR 4354. (2H,3L,3C)

#### 4304: NONPOINT SOURCE POLLUTION MODELING AND MANAGEMENT

Concepts, principles and application of modeling and monitoring for assessment and management of nonpoint source pollution. Design and implementation of monitoring systems. Concepts of modeling agroecosystems and land use impacts on hydrologic/water quality response of upland catchments. Model selection, calibration, validation, and application for comparative analysis. Screening models using Geographic Information Systems. Case studies in current watershed management issues, with a focus on agricultural waste and nutrient management, using existing field and watershed models. Pre: 3334. (2H,3L,3C)

#### 4344: GEOGRAPHIC INFORMATION SYSTEMS FOR ENGINEERS

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 and senior standing required. (2H,3L,3C)

#### 4394: WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES

Social, economic and engineering principles of water supply and sanitation in developing countries as affected by climate, cultural and sociological factors, and material and financial resources. Pre: CEE 3104. (3H,3C)

#### 4524: BIOLOGICAL PROCESS PLANT DESIGN

Engineering principles for design of systems for processing biological materials into primary and secondary products. Delivery, scheduling, storage requirements, economic analysis. Process control and instrumentation of bioprocessing plants. Pre: 3534. (3H,3C)

#### 4544 (CHE 4544): 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. Pre: 3504 or CHE 3144. (3H,3C)

#### 4564: METABOLIC ENGINEERING

Engineering concepts for analyzing, designing, and modifying metabolic pathways to convert raw materials to food, pharmaceuticals, fuels and chemicals. Cell metabolism, pathway design, bioenergetics, regulatory mechanisms, metabolic modeling, and genetic tools. Pre: 3534. (3H,3C)

#### 4604: FOOD PROCESS ENGINEERING

Analysis and design of food processing operations including thermal pasteurization and sterilization, freezing, extrusion, texturization, and mechanical separation. Pre: 3504, 3524. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Biological Systems Engineering

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### Overview

The Biological Systems Engineering program integrates biology, chemistry, and physics with engineering to solve engineering problems associated with the environmentally sound production, processing, and utilization of renewable resources. The curriculum differs from other engineering programs in that it focuses on biological materials and the sustainable production and management of natural resources. Biological Systems Engineering graduates have rewarding careers working with biological materials and both large and small biological systems, for the benefit of society and the environment.

The BSE program is designed to graduate biological systems engineers who will be leaders in applying engineering principles to biological systems, preparing graduates to accomplish the following objectives in their careers:

design and implement systems that mimic or adapt natural biological processes to solve problems related to conservation and restoration of natural resources;

- design and implement processes to utilize biological materials for sustainable production of valuable products;
- promote stewardship of natural resources; and
- contribute effectively as members of multidisciplinary groups that include scientists, engineers, and community members.

These educational objectives are supported by a curriculum that provides its graduates with:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments as well as analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multidisciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in global and societal context
- a recognition of need for, and ability to engage in lifelong learning
- a knowledge of contemporary issues
- an ability to use techniques, skills and modern engineering tools necessary for engineering practice

The BSE program provides a strong, broad-based engineering education with opportunity for specialization utilizing the 33 credits of technical electives available in the curriculum. Using these electives, BSE students prepare for careers in biomedical engineering, biotechnology, biopharmaceuticals, food engineering, or watershed science and engineering. Many BSE graduates also choose to pursue graduate studies or professional degrees from medical, veterinary, or dental programs.

Recognizing the importance of "hands-on" experience in engineering education, instructional laboratories are included in many of the Biological Systems Engineering courses. These laboratory courses are designed to enhance understanding of theoretical concepts through hands-on activities. In addition to providing a strong and broad-based engineering education, the program emphasizes communication, team work skills, and design experience. The department participates in the Cooperative Education Program, which gives qualified students valuable work experience while pursuing an undergraduate degree. Students are also encouraged to participate in undergraduate research and study abroad programs. Many BSE students are employed in departmental research laboratories.

Design and teamwork experiences are integral parts of the program. In the second year, students work in teams to design, build, and test a solution to an assigned design problem. Throughout the junior year, students acquire knowledge and analytical skills required for successful and professional engineering design through course assignments. The senior year design sequence gives students a comprehensive design experience in which they utilize much of the knowledge they have acquired through their other courses. Students work in teams to solve "real-life" engineering problems.

The Bachelor of Science in biological systems engineering is offered through the College of Engineering and is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

The relatively small class sizes in Biological Systems Engineering promote excellent interaction between faculty and students.

The department offers over 20 endowed scholarships to students enrolled in Biological Systems Engineering; students are also eligible for College of Engineering and other university scholarships.

In addition to the undergraduate degree program, programs of study leading to master of engineering, Master of Science, and Ph.D. degrees are available in the department. The BSE department also participates in the Accelerated Undergraduate/Graduate degree program. Through this program, undergraduate students with a GPA of 3.4 or above can apply for admission to the Graduate School during their junior year. If admitted, students may apply up to 12 hours of graduate coursework to both their graduate and undergraduate degree requirements, thus accelerating completion of a master's degree in BSE.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

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### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

**3134: BIOLOGICAL SYSTEMS ENGINEERING SEMINAR**

Critical review of technical and professional articles on current topics in Biological Systems Engineering. Development of oral presentation and technical writing skills. Contemporary ethical, professional, and global issues in Biological Systems Engineering. Pre: 2004. (2L,1C)

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Solving engineering problems related to biological systems using numerical analysis including root finding, numerical integration, differentiation, interpolation and numerical solution of ordinary differential equations. Error analysis and programming with engineering software. Course requirements may be satisfied by taking MATH 2214 prior to or concurrent with course. Co: MATH 2214. (2H,2C)

**3154: THERMODYNAMICS OF BIOLOGICAL SYSTEMS**

Fundamental concepts, first and second laws, psychrometrics applied to plant and animal environments, introduction to Gibbs energy, and application of calorimetry to gain basic understanding of energy flow in a biological system. Course requirements may be satisfied by taking CEE 3304 or CHE 3114 or ESM 3234 or ESM 3024 or ME 3404 prior to or concurrent with course. Pre: ESM 2304, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). (3H,3C)

**3324: SMALL WATERSHED HYDROLOGY**

Precipitation, soil physics, infiltration, evapotranspiration, groundwater hydrology, overland flow, open channel flow, flow routing, hydraulic analysis. Course requirements may be satisfied by taking CEE 3304 or CHE 3114 or ESM 3234 or ESM 3024 or ME 3404 prior to or concurrent with course. (3H,3C)

**3334: NONPOINT SOURCE POLLUTION ASSESSMENT AND CONTROL**

Erosion prediction and control; transport and fate of sediment, nutrients, and microorganisms; design of nutrient management plans, wetlands, detention facilities and other management practices for rural and urban nonpoint source pollution control. Pre: 3324. (2H,3L,3C)

**3494: ADVANCED WELDING TECHNOLOGY**

Techniques in welding that include gas, submerged metal arc, metal inert gas, pulsed arc, and tungsten inert gas welding. Design of welding structures, fundamentals of heat treatment, and plasma arc cutting. Consent required. (3L,1C)

**3504: TRANSPORT PROCESSES IN BIOLOGICAL SYSTEMS**

Introduction to material and energy balances in biological systems. Fundamentals of heat and mass transfer in biological systems. One and two dimensional conduction, convection, and diffusion of thermal energy and mass. Heat and mass transfer rates, steady and unsteady state conduction, convection, diffusion; design of simple heat exchangers. Application of these topics and fluid mechanics to fluid handling, bacterial growth, plant nutrient uptake, enzymatic reactions. Pre: 3154, ESM 3024. (3H,3C)

**3524: UNIT OPERATIONS IN BIOLOGICAL SYSTEMS ENGINEERING**

Unit operations for processing biological materials including heat exchangers, evaporation, drying, mixing, homogenization, extrusion, phase and multi-phase separation, and size reduction. Laboratory hands-on experience in various unit operations. Course requirements may be satisfied by taking BSE 3504 prior to or concurrent with course. Co: 3504. (2H,3L,3C)

**3534: BIOPROCESS ENGINEERING**

Engineering concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals. Metabolic pathways leading to products, enzyme kinetics, cell growth kinetics, and analysis of bioreactors and fermenters. Co: 3504, (BIOL 2604 or BIOL 2604H). Pre: 3154. Co: BIOL 2604, 3504. (3H,3C)

**4125-4126: COMPREHENSIVE DESIGN PROJECT**

4125: Identify and develop an engineering design project using the team approach; use of literature resources to define project objectives and approach; present project proposal in a professional written and oral manner; engineering ethics, professionalism and contemporary issues. Pre: Completion of 96 hours, overall GPA of 2.0 or better. 4126: Complete a comprehensive design project using the team



approach, test approach, test prototype, and prepare and present a professional engineering design report. Pre: 3334 or 3524 for 4125; 4125 for 4126. 4125: (1H,3L,2C) 4126: (1H,6L,3C)

#### 4204: INSTRUMENTATION FOR BIOLOGICAL SYSTEMS

Introduction to instrumentation and sensors for measurement and control of biological systems. Sensor response dynamics, data acquisition, sensor selection, signal processing and signal conditioning principles. Experimental determination of velocity, pressure, strain, displacement, forces and chemical constituents. Data analysis focused on uncertainty, error and statistical concepts. Pre: PHYS 2306, ESM 3024. (2H,2L,3C)

#### 4224: FIELD METHODS IN HYDROLOGY

Site characterization: surveying, channel and floodplain mapping, land use, electronic data acquisition. Techniques for measuring surface and subsurface hydrologic processes: water flow, hydrologic conductivity, precipitation, evaporation. Sampling techniques: surface water, groundwater, and soil pore water sampling. In-situ monitoring: automatic samplers, dataloggers, water quality sondes. Laboratory analyses: good laboratory practices, selection of analytical method, calibration, quality assurance/quality control. Co: 3324 or CEE 3314 or FOR 4354. (2H,3L,3C)

#### 4304: NONPOINT SOURCE POLLUTION MODELING AND MANAGEMENT

Concepts, principles and application of modeling and monitoring for assessment and management of nonpoint source pollution. Design and implementation of monitoring systems. Concepts of modeling agroecosystems and land use impacts on hydrologic/water quality response of upland catchments. Model selection, calibration, validation, and application for comparative analysis. Screening models using Geographic Information Systems. Case studies in current watershed management issues, with a focus on agricultural waste and nutrient management, using existing field and watershed models. Pre: 3334. (2H,3L,3C)

#### 4344: GEOGRAPHIC INFORMATION SYSTEMS FOR ENGINEERS

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 and senior standing required. (2H,3L,3C)

#### 4394: WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES

Social, economic and engineering principles of water supply and sanitation in developing countries as affected by climate, cultural and sociological factors, and material and financial resources. Pre: CEE 3104. (3H,3C)

#### 4524: BIOLOGICAL PROCESS PLANT DESIGN

Engineering principles for design of systems for processing biological materials into primary and secondary products. Delivery, scheduling, storage requirements, economic analysis. Process control and instrumentation of bioprocessing plants. Pre: 3534. (3H,3C)

#### 4544 (CHE 4544): 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. Pre: 3504 or CHE 3144. (3H,3C)

#### 4564: METABOLIC ENGINEERING

Engineering concepts for analyzing, designing, and modifying metabolic pathways to convert raw materials to food, pharmaceuticals, fuels and chemicals. Cell metabolism, pathway design, bioenergetics, regulatory mechanisms, metabolic modeling, and genetic tools. Pre: 3534. (3H,3C)

#### 4604: FOOD PROCESS ENGINEERING

Analysis and design of food processing operations including thermal pasteurization and sterilization,

freezing, extrusion, texturization, and mechanical separation. Pre: 3504, 3524. (3H,3C)

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Center for 21st Century Studies

[Overview](#)

[Minor for 21st Century Studies](#)

[Undergraduate Course Descriptions \(C21S\)](#)

**Director:** Robert Siegle

**Web:** [www.c21s.clahs.vt.edu](http://www.c21s.clahs.vt.edu)

## Overview

The minor in 21st Century Studies complements many majors across the university by offering students new ways of thinking about the complicated issues of 21st century life around the world. Transdisciplinary and internationally focused, the program requires students to study abroad between the spring introductory course and the fall capstone in which they complete a year-long research project using both traditional and nontraditional methods and materials.

## Minor in Leadership Studies

The minor is composed of 18 hours, six of them from the list of approved electives on the checksheet, and twelve from the following courses:

- C21S 2104: Introduction to 21st Century Studies (3h)
- C21S 3954: Study Abroad (6h); an alternative study abroad may count subject to approval by the Center Director
- C21S 4004: Capstone Seminar (3h)

Minors must also satisfy the Center's Foreign Language Requirement in one of three ways: by passing at

least four years of a single high school foreign language, by passing 2106 in their language of choice, or by proficiency verified by CLEP exam for any foreign language at 2106 level.

A minimum of 18 hours and a minor GPA of 2.0 are required for the minor. Courses used to fulfill a major may not count as electives for this minor.

## Undergraduate Course Descriptions (C21S)

### 2104: INTRODUCTION TO TWENTY-FIRST CENTURY STUDIES

An introduction to issues and resources in 21st century studies: the interaction of tradition and modernity as it plays out in human and economic development, levels of governance from local to global, social forms (gender, family, class, nation, ethnicities, human rights), and cultural forms (art, changing mores, media, religion, technology, the built environment); the art, ideas, and issues of the 21st century. (3H,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2974H: INDEPENDENT STUDY

Honors Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3954: STUDY ABROAD

Variable credit course.

### 4004: CAPSTONE SEMINAR

Capstone research/project seminar for the minor in C21S. Research skills, engagement with the most recent scholarship and other cultural responses to 21st century issues, presentation, and dissemination. Pre: 3954 with at least a C grade. Pre: 3954. (3H,3C)

### 4754: INTERNSHIP

Variable credit course.

### 4974: INDEPENDENT STUDY

Variable credit course.

### 4974H: INDEPENDENT STUDY

Honors Variable credit course.

### 4984: SPECIAL STUDY

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Civil and Environmental Engineering

[Overview](#)

[Civil Engineering Program](#)

[Undergraduate Course Descriptions \(CEE\)](#)

**Head and Montague-Betts Professor of Structural Steel Design:** W.S. Easterling

**Assistant Head and Charles E. Via, Jr. Professor:** G.M. Filz

**Assistant Head and Professor:** M.A. Widdowson

**Burrows Professor:** R.T. Leon

**Charles E. Via, Jr. Professor:** J. C. Little

**Charles Lunsford Professor:** M.A. Edwards

**Newport News Shipbuilding Professor:** T.A. Dingus

**Samuel Reynolds Pritchard Professor:** H.A. Rakha

**Vecellio Professor:** J.M. de la Garza

**W. Curtis English Professor:** W.R. Knocke

**W. Thomas Rice Professor:** A. Pruden

**Professors:** G.D. Boardman, T.L. Brandon, F.A. Charney, A.M. Dietrich G.W. Flintsch, R.A. Green, L.C. Marr, G.E. Moglen, C.L. Roberts-Wollmann, A. Rodriguez-Marek, S.K. Sinha, A.A. Trani, P.J. Vikesland, and L. Wang

**Associate Professors:** M.M. Abbas, D.E. Dickerson, R.L. Dymond, D.L. Gallagher, M.J. Garvin, Z. He, K.P. Heaslip, J.L. Irish, K.L. Hancock, M. Mauldon, C.D. Moen, P.M. Murray-Tuite, and K. Strom

**Assistant Professors:** M.R. Eatherton, M.M. Flint, M.H. Hebdon, E.T. Hester, S. Hotle, G. Isaacman-VanWertz, F. Jazizadeh Karimi, I.A. Koutromanos, M. Shakiba, E.W. Shealy, N. Stark, D.R. Simmons, Z.W. Wang, and K. Ziotospoulou

**Associate Professors of Practice:** J. Dove

**Assistant Professors of Practice:** B.J. Katz, V.A. Mouras, R.P. Scardina, and K. D. Young

**Research Associate Professor:** A. Godrej

**Research Assistant Professor:** C.G. Olgun and H. Zhang

**Professors Emeritus:** T.E. Cousins, W.E. Cox, D.R. Drew, J. M. Duncan, T.J. Grizzard, R.C. Hoehn, S.M. Holzer, J.M. Hughes, D.F. Kibler, T. Kuppusamy, J.K. Mitchell, T.M. Murray, J. T. Novak, R. H. Plaut, C.W. Randall, K.B. Rojjani, D. Teodorovic, M.C. Vorster, and R.E. Weyers

**Academic and Career Advisor:** K.E. Lattimer

**Coordinator of Alumni and External Relations: C.E. Long**

Web: [www.cee.vt.edu](http://www.cee.vt.edu)

## Overview

The Charles Edward Via, Jr. Department of Civil and Environmental Engineering offers an undergraduate program that facilitates development of critical analytical abilities and the necessary core of knowledge and skills for entry into the civil engineering profession or graduate studies. This body of knowledge includes the scientific procedures for formulating and testing theories and the procedures for applying theory to enhance welfare through engineering analysis, synthesis, and design. The civil engineer plays a key role in the design, construction, maintenance, and management of society's physical infrastructure, including transportation and communication systems, structural facilities for housing human activities, water resource management systems, natural resource development systems, and facilities and programs for environmental protection. The Bachelor of Science program in Civil Engineering is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

Emphasis in civil engineering education is on fundamental principles of science and mathematics and their application to solving human problems. Civil engineering activities interact in many ways with the natural and social environments within which they take place. Accordingly, the civil engineering program strives to create an awareness of the ecological, social, economic, and political context of engineering and attempts to prepare the civil engineer for the necessary interactions with other professions and the public. An effort to instill an understanding of the role of the civil engineer in satisfying total societal needs is an integral part of the civil engineering program.

Consistent with the general program goal of facilitating development of student competence necessary for entry into engineering practice or graduate school, the Department has developed the following program objectives:

Within a few years of program completion, graduates of the Civil and Environmental Engineering Department 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 civil engineering practice in the analysis, evaluation, design, and construction of civil 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 civil 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.

The curriculum provides a common freshman and sophomore year, with selection of upper division courses made during course request for the second semester of the sophomore year. The civil engineering curriculum provides breadth across the civil engineering profession and the opportunity for depth within a student's selected specialty areas of interest. Specialty areas offered within the department include: construction engineering & management, environmental engineering, geotechnical engineering, land development, civil engineering materials, structural engineering, transportation engineering, and water resources engineering.

Students are progressively exposed to civil engineering design, culminating in a focused design course experience. The projects assigned in design courses are open-ended, incorporate appropriate engineering standards, and require the application of knowledge from earlier courses in the curriculum. Projects apply technical knowledge to design appropriate physical facilities, but also include consideration of non-technical constraints that confront real-world projects. These additional considerations include such interdisciplinary issues as economics, environmental impact, and sustainability. Accordingly, teamwork and good professional communications skills are a significant part of each design project course experience.

Classroom instruction in the civil engineering program is reinforced by instructional laboratories in the major areas of civil engineering practice. The department seeks to employ the latest educational technology and innovative teaching methods.

The department participates in the Cooperative Education Program in which qualified students may alternate semesters of study with semesters of professional employment. The department encourages all students to participate in professional work experience prior to graduation.

Contact person for undergraduate Civil and Environmental Engineering programs is Kara Lattimer, CEE Academic and Career Advisor at (540) 231-7148 or e-mail: [karalatt@vt.edu](mailto:karalatt@vt.edu).

Full programs of graduate study are available, leading to the M.Eng., M.S., and Ph.D. in civil engineering. Graduate degree programs concentrate in one of five major areas: construction engineering and management, environmental and water resources engineering, geotechnical engineering, structural engineering and materials, and transportation and infrastructure systems engineering. For details, see the [Graduate Catalog](#).

## Civil Engineering Program

Admission to a degree program is competitive, with departmental restrictions established each year by the college. Entry into a degree-granting department requires that a student complete all first year required courses and maintain a competitive GPA. Applicants with a minimum 3.0 overall are guaranteed first choice of major. More information is available through the Engineering Education Department: [www.enge.vt.edu/undergraduate-changing-majors.html](http://www.enge.vt.edu/undergraduate-changing-majors.html).

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Undergraduate Course Descriptions (CEE)

### 2804: INTRODUCTION TO CIVIL AND ENVIRONMENTAL ENGINEERING

Overview of the civil engineering profession and the undergraduate program of study. The fundamentals of good oral and written communication skills for the Civil Engineer are emphasized. An introduction to engineering library resources is also included. A grade of C- or better required in prerequisites. Pre: ENGE 1024 or ENGE 1215. (3H,2C)

#### 2814: CIVIL AND ENVIRONMENTAL ENGINEERING MEASUREMENTS

Introduction to various data measurement issues in civil and environmental engineering, including collection techniques, analysis, error, and statistical evaluation in all sub-disciplines. Spatial measurement topics include GPS, leveling, distance and angular measurement, mapping and topographic surveys, automated data collection, terrain models, earthwork methods, construction surveying, geodesy, and GIS. A grade of C- or better required in pre-requisites. Pre: BC students required to take the BC 1224 pre-requisite, BC and CEM students are exempt from corequisite CEE 2824. CEE students are required to take the ENGE 1216 pre-requisite. Pre: (ENGE 1114 or ENGE 1216 or ENGE 1434 or BC 1224), (MATH 1206 or MATH 1206H or MATH 1226). Co: 2824. (3H,3L,4C)

#### 2824: CIVIL ENGINEERING DRAWINGS AND CAD

Introduction to the use of Computer-Aided Drafting (CAD) software in civil engineering, construction, and other land development projects. Interpretation of typical civil engineering drawings. Creation of land development plans, cross section and profile drawings, and detail drawings utilizing computer-aided design and drafting tools. Creation of two- and three- dimensional visualizations of civil engineering, construction, and other land development projects. (1H,1C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3014: CONSTRUCTION MANAGEMENT

Fundamental elements involved in managing construction projects. Management structure, construction contracts, equipment and labor productivity, scheduling, quality assurance, and cost control. Junior standing required. (2H,3L,3C)

#### 3104: INTRODUCTION TO ENVIRONMENTAL ENGINEERING

Overall view of environmental engineering with emphasis on hazardous waste management, water treatment, wastewater treatment, air pollution and its control, solid waste management, groundwater pollution and environmental regulations. A grade of C- or better required in pre-requisites. Pre: (CHEM 1035 or CHEM 1074), (CHEM 1045 or CHEM 1084), (MATH 1206 or MATH 1206H or MATH 1226 or MATH 2016 or MATH 2024), (PHYS 2305 or PHYS 2205). (3H,3C)

#### 3274: INTRODUCTION TO LAND DEVELOPMENT DESIGN

An introduction to the land development design process including site selection and feasibility, environmental considerations, utility layout, grading, stormwater management and integrating planning with the design of infrastructure to support residential and commercial development. A grade of C- or better in prerequisite. Pre: 2814. (3H,3C)

#### 3304: FLUID MECHANICS FOR CIVIL AND ENVIRONMENTAL ENGINEERING

Hydrostatics; fluid motion; continuity, momentum, and energy equations; viscous effects; applications to pipe networks and hydraulic systems, including open channel flow. Laboratory experiments and demonstrations. A grade of C- or better in pre-requisite ESM 2104. Pre: ESM 2104. (3H,2L,3C)

#### 3314: WATER RESOURCES ENGINEERING

Open channel flow; hydrology; hydraulic modeling; hydraulic machinery and structures; laboratory experiments and demonstrations. A grade of C- or better required in pre-requisite 3304. Pre: 3304. (3H,2L,3C)

#### 3404: THEORY OF STRUCTURES

Fundamental tools and methods of structural analysis: moment-area, slope-deflection, force, and moment-distribution methods. Influence lines. Application to beams, trusses, and simple frames. A grade of C- or better required in pre-requisite ESM 2204. Pre: ESM 2204. (3H,3C)



#### 3424: REINFORCED CONCRETE STRUCTURES I

Behavior and design of reinforced concrete members based on ultimate strength. Beams and slabs in flexure, shear and torsion, development of reinforcement. Columns with axial force plus bending, slenderness effects in columns. A grade of C- or better required in prerequisites. Pre: (3404, 3684) or BC 2044. (3H,3C)

#### 3434: DESIGN OF STEEL STRUCTURES I

Behavior and design of structural steel members and steel-frame buildings, including simple and fixed connections. AISC specifications; elastic theory. Design members to resist tension, compression, bending, torsion; plate girders, composite beams. ESM 3054 may be taken in place of co-requisite CEE 3684. A grade of C- or better in prerequisite. Pre: (3404, 3684) or BC 2044. (2H,3L,3C)

#### 3514: INTRODUCTION TO GEOTECHNICAL ENGINEERING

Engineering properties of soils including their descriptions and classifications, the effects of water, soil strength and compressibility. Introduction to soil stabilization, earth pressures, slope stability, and foundations. A grade of C- or better required in pre-requisites GEOS 2104 and ESM 2204. Pre: ESM 2204, (GEOS 1004 or GEOS 2104 or GEOL 1004 or GEOL 2104). (2H,2L,3C)

#### 3604: INTRODUCTION TO TRANSPORTATION ENGINEERING

Planning, design and operation of transportation systems with emphasis in multimodal transportation techniques and unified system engineering theories to analyze large scale transportation problems. Discussion of Intelligent Vehicle Highway Systems (IVHS) and hands on experience in computer models in transportation operations and planning. Interactions between transportation infrastructure and environmental engineering planning. Junior standing required. (3H,3C)

#### 3684: CIVIL ENGINEERING MATERIALS

Characteristics of constituent materials and the design and behavior of portland cement and bituminous concrete mixtures with demonstrated laboratory experiments. A grade of C- or better required in prerequisites. Pre: CHEM 1035, CHEM 1045, ESM 2204, CEE 2814, (GEOS 2104 or GEOS 1004). (2H,3L,3C)

#### 3804: COMPUTER APPLICATIONS FOR CIVIL AND ENVIRONMENTAL ENGINEERS

Introduction to computer applications in civil and environmental engineering. Integration of design, data management, computer programming and problem solving skills with computer tools and techniques. Topics include systems analysis, optimization, database management, computer programming and data structures. Junior Standing Required. (2H,2L,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4014 (BC 4024): ESTIMATING, PRODUCTION, AND COST ENGINEERING

Interpretation of plans and specifications, preparation of construction estimates, and cost control. Methods analysis, resource requirements, and resource costs in building systems, including system components, and in large-scale civil engineering works such as highways, bridges, and hydraulic structures. A grade of C- or better required in pre-requisite 3014. Pre: 3014. (3H,3C)

#### 4024: CONSTRUCTION CONTROL TECHNIQUES

Techniques used to plan, schedule, and control the Construction Process. Emphasizes manual and computer-based approaches. Focuses on an analytical approach towards the construction process whereby good technical methodologies and solutions are converted to reality through construction practices. A grade of C- or better required in prerequisite. Pre: 3014. (3H,3C)

#### 4074: CONSTRUCTION ENGINEERING: MEANS AND METHODS

Construction means, methods, and equipment used to transform a particular design concept into a completed usable structure or facility. Selection and optimization of individual units as well as the systems needed to produce the required work to the required quality on time and on budget. A grade of C- or

better required in prerequisite. Pre: 3014. (3H,3C)

#### 4104: WATER AND WASTEWATER TREATMENT DESIGN

Design of municipal water and wastewater treatment plants. Emphasis on characterization of water and wastewater and physical, chemical, and biological treatment methods. Sludge processing advanced treatment methods and treatment plant hydraulics are considered. A grade of C- or better required in prerequisites. Pre: 3104, 3304. (3H,3C)

#### 4114: FUNDAMENTALS OF PUBLIC HEALTH ENGINEERING

Public health engineering principles for protection against biological and chemical health hazards. Emphasis on major communicable diseases that plague mankind, organisms that cause them, routes of transmission, and engineering methods of control. Appropriate control methods for rural areas and developing countries. A grade of C- or better required in pre-requisite. Pre: 3104. (3H,3C)

#### 4134: ENVIRONMENTAL SUSTAINABILITY - A SYSTEMS APPROACH

Quantitative methods to evaluate environmental sustainability using a systems approach. Sustainability assessment frameworks, orientors and indicators, indicators of sustainable development, green-house gas emissions, renewable energy systems, whole-system design, economic systems and input-output techniques, system dynamics models, emergence and agent-based models. Class project requiring integration of environmental, economic and social systems using system dynamics and agent-based models. Senior Standing. Pre: MATH 2214. (3H,3C)

#### 4144: AIR RESOURCES ENGINEERING Effects, regulation, sources, and control of air pollution.

Application of engineering calculations and models to estimate emissions, predict pollutant concentrations, and design pollution control equipment. Senior standing required. A grade of C- or better required in prerequisites. Pre: 3104 or ENGR 3124 or GEOS 3114 or ENSC 3634. (3H,3C)

#### 4164: ENVIRONMENTAL MICROBIOLOGY

Ecology, physiology, and diversity of soil and aquatic microorganisms; incorporates the significance of these topics within the context of environmental applications such as bioremediation, wastewater treatment, control of plant-pathogens in agriculture, and pollution abatement in natural systems. The laboratory portion of the course will stress methodology development, isolation and characterization of microorganisms from natural and engineered systems, and examination of the roles of microorganisms in biogeochemical cycling. Biology students are exempt from CEE 3104, but must take BIOL 2604 and obtain a C- or higher. A grade of C- or better required in prerequisites. Pre: BIOL 2604 or CEE 3104. (2H,3L,3C)

#### 4174: SOLID AND HAZARDOUS WASTE MANAGEMENT

Introduction to the problems, regulations and techniques associated with the management of solid and hazardous waste. Composition, volume and characterization of the wastes. Design of collection and disposal systems, including landfills, solidification/stabilization and incineration. A grade of C- or better required in pre-requisite 3104. Pre: 3104. (3H,3C)

#### 4254: MUNICIPAL ENGINEERING

An introduction to the field of municipal engineering. Infrastructure, capital projects, financing, sustainability, disaster planning and response, and plan review for development projects. Senior standing required. (3H,3C)

#### 4264: SUSTAINABLE LAND DEVELOPMENT

An introduction to the modern techniques for developing land while maintaining a focus on long-term sustainability. Topics include site layout, stormwater impact, air quality and microclimate, living resources, LEED and EarthCraft development standards. Pre-requisite: Senior Standing required (3H,3C)

#### 4274: LAND DEVELOPMENT DESIGN

Overview of land development projects including factors, construction practices, legal issues, and government policies. Design project includes feasibility study, engineering evaluation of site, and layout design of lots, buildings, streets, sewers, etc. Interactive graphics and automated drafting. Senior standing in Civil Engineering required. A grade of C- or better required in prerequisite. Pre: 3274. (2H,3L,3C)

#### 4284: ADVANCED LAND DEVELOPMENT DESIGN

Advanced course in land development design focusing on site grading and parking, stormwater management, and erosion control. Reviews project design criteria and applicable municipal and state guidelines. Uses CAD software for design and deliverables. Senior/Graduate standing required. A grade of C- or better required in pre-requisites. Pre: 3274. Co: 4274. (3H,3C)

#### 4304: HYDROLOGY

Precipitation, evaporation, consumptive use, infiltration; stream flow, flood routing; statistical analysis of hydrologic data, flood and drought forecasting, risk analysis, subsurface flow, well hydraulics, introduction to urban drainage design. A grade of C- or better required in pre-requisite. Pre: 3304. (3H,3C)

#### 4314: GROUNDWATER RESOURCES

Fundamentals of groundwater hydrology; flow through porous media, both saturated and unsaturated; flow to wells in both confined and unconfined aquifers; seepage of groundwater to canals and field drains; analysis of aquifer test data to quantify flow and storage parameters; contaminants in groundwater, basic introduction to groundwater modeling. A grade of C- or better required in pre-requisite 3304. Pre: 3304. (3H,3C)

#### 4324: OPEN CHANNEL FLOW

Mechanics of open channel flow, including uniform flow, gradually varied flow, channel transitions, and unsteady flow. Pre: 3314. (3H,3C)

#### 4334: HYDRAULIC STRUCTURES

Hydraulic analysis and design of engineering structures for water control, including reservoirs, dams, spillways, spilling basins, drainage structures, and hydraulic models. A grade of C- or better required in pre-requisite 3314. Pre: 3314. (3H,3C)

#### 4344: WATER RESOURCES PLANNING

Analysis of the water resources planning process and the institutional framework for water resources management. Criteria and procedures for evaluating management alternatives are examined, with emphasis on assessment of economic and environmental impacts. Senior standing required. (3H,3C)

#### 4354: ENVIRONMENTAL HYDROLOGY

Overall view of pollutants movements in surface waters, with emphasis on the role of various hydrologic processes. Natural and constructed wetlands and their use for water quality control. Fundamentals of river hydraulics. Design of flood control channels. Environmental consequences of various types of hydraulic systems. Mitigation, enhancement, and restoration techniques. A grade of C- or better required in pre-requisites 3104 and 3314. Pre: 3104, 3314. (3H,3C)

#### 4384: COASTAL ENGINEERING

Basic wave mechanics principles, surf-zone processes, littoral and sediment processes, shoreline features, astronomical tides, coastal hazards, and functional design of coastal structures. Field trips. Pre: C- or better in 3304. Pre: 3304. (3H,3C)

#### 4404: COMPUTER ANALYSIS OF STRUCTURES I

Formulation of matrix displacement method in a form suitable for program development. Application to trusses and frames. Incorporation of special features such as symmetry, internal releases, support settlements, and influence lines. Initiation of program development. Use of existing programs on the personal computer. A grade of C- or better required in pre-requisite 3404. Pre: 3404. (3H,3C)

#### 4454: MASONRY STRUCTURAL DESIGN

Masonry materials, material testing, material specifications. Structural behavior and design of masonry elements (walls, beams, and columns) and systems used in structures. Construction techniques and the details of masonry construction. Building codes relating to analysis and design of masonry structures. A grade of C- or better required in pre-requisites 3424 and 3684. Pre: 3684, 3424. (3H,3C)

#### 4514: METHODS IN GEOTECHNICAL ENGINEERING

Principles and techniques for characterizing earth materials (soil and rock) for civil engineering projects in various regional environments; with emphasis on the interdisciplinary approach to field exploration and

site description through soil mechanics theory, geologic correlations, geophysical methods, in site testing and sampling. A grade of C- or better required in pre-requisite 3514. Pre: 3514. (3H,3C)

#### 4534: EARTH PRESSURES AND FOUNDATION STRUCTURES

Earth pressure theories and their applications to the design of retaining structures, anchors, and excavation bracing. Bearing capacity and settlement of shallow foundations. Types and capacity of deep foundations. A grade of C- or better in pre-requisite 3514. Pre: 3514. (3H,3C)

#### 4544: DESIGN OF EARTH STRUCTURES

Application of geotechnical engineering principles in the design and construction of earth structures. Subsurface models, shear strength of soil, slope stability, earth fills, earth retention, ground improvement, sustainability considerations, geotechnical reporting. Team-based design project. C- or better in 3514. Pre: 3514. (3H,3C)

#### 4554: NATURAL DISASTER MITIGATION AND RECOVERY

Causes, mechanics, classifications, and forces associated with tornadoes, hurricanes, floods, earthquakes, and landslides. Resistance evaluation for existing ground, facilities and structures. Hazard-resistant design of new facilities. Risk and reliability assessment and decision analysis. Strategies and designs for natural disaster risk mitigation. Emergency response for protection of life and property and restoration of lifelines. Includes an interdisciplinary team project. Prerequisite: Senior Standing Required (3H,3C)

#### 4564: INTRODUCTION TO COASTAL AND MARINE GEOTECHNICS

Geotechnical aspects of coastal and marine engineering. Introduction to the coastal zone as a working environment. In-situ geotechnical methods and complementary techniques for investigation. Survey strategies. Local field trips for demonstrating methods, practice and design. A grade of C- or better is required in prerequisite 3514. Pre: 3514. (3H,3C)

#### 4604: TRAFFIC ENGINEERING

Study of traffic and parking characteristics; application of traffic control devices; principles and techniques used to improve the efficiency and safety of traffic flow systems. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4614: ADVANCED CIVIL ENGINEERING MATERIALS

Fundamental properties and the physical and chemical aspects of the structure of Portland cement concretes. Emphasis placed on environmental performance aspects and the application of studies of concrete performance under various exposure conditions. A grade of C- or better required in pre-requisite 3684. Pre: 3684. (3H,3C)

#### 4624: PLANNING TRANSPORTATION FACILITIES

Transportation planning process; urban and regional studies, surveys, data analysis, model development and testing; transportation management, administration, finance, system evaluation, implementation, and integration. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4634: INFRASTRUCTURE CONDITION ASSESSMENT

Infrastructure components and assessment needs; physical and chemical properties of construction materials; deterioration causes, assessment methods, nondestructive evaluation techniques, infrastructure management systems, performance models, service-life-cycle estimates. A grade of C- or better required in pre-requisite 3684. Pre: 3684. (3H,3C)

#### 4644: 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. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4654: GEOMETRIC DESIGN OF HIGHWAYS

Functional design of highways; curves, intersections, interchanges, drainage, and other features involved in highway safety and traffic efficiency. A grade of C- or better required in pre-requisite 3604. Pre: 3604.

(3H,3C)

**4664: PAVEMENT DESIGN**

Principles underlying methods for the design of various elements of flexible and rigid pavements for highways and airports; climate and traffic effects; pavement management systems. A grade of C- or better required in pre-requisite 3684. Pre: 3684. (3H,3C)

**4674: AIRPORT PLANNING AND DESIGN**

Airport planning and economic justification, site selection, configuration, development and design of terminal areas, demand forecasting, access, traffic control. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

**4684: TRANSPORTATION SAFETY**

Basic principles associated with transportation safety related to humans, vehicles and infrastructure as well as principles of design for safety and practices of empirical evaluation of safety. Principles and practices of accident investigation and injury epidemiology as well as safeguards and control practices. A grade of C- or better required in prerequisite. Pre: 3604. (3H,3C)

**4804: PROFESSIONAL AND LEGAL ISSUES IN ENGINEERING**

Analysis of the legal, professional, and ethical aspects of engineering practice; introduction to contract law and contract dispute resolution, professional liability, and other aspects of law relevant to engineering practice; professional registration and codes of ethics. Pre: Senior standing in engineering. (3H,3C)

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Chemical Engineering

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### Overview

#### Chemical Engineering Program

#### Undergraduate Course Descriptions (CHE)

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**Head:** David F. Cox

**Alexander F. Giacco Professor:** D.G. Baird

**Alumni Distinguished Professor and Frank C. Vilbrandt Professor:** Y.A. Liu

**Professors:** L.E.K. Achenie, R.M. Davis, W.A. Ducker, E. Kiran, and C. Lu

**Robert H. Hord Jr. Faculty Fellow and Professor:** P. Rajagopalan

**Associate Professors:** A.S. Goldstein, A.M. Karim, S.M. Martin, and A.R. Whittington

**Assistant Professors:** M Bortner, S. Deshmukh, R. Tong, and H. Xin

**Adjunct Professors:** P.L. Durrill, E.G. Joseph, G.E. Keller II, S.T. Oyama, P.K. Shin, and J.Y. Walz

**Affiliated Research Faculty:** K. Forsten Williams

**Joseph H. Collie Distinguished Visiting Professor:** Gary Whiting

**University Distinguished Professor Emeritus:** G.L. Wilkes

**Professor Emeritus:** W.L. Conger, P.R. Rony, J.T. Sullivan, and G.B. Wills

**ChE Co-op Advisor:** A.S. Goldstein

Web: [www.che.vt.edu](http://www.che.vt.edu)

## Overview

Skillful and creative applications of the principles of chemistry, biochemistry, biology, mathematics, and physics are needed to solve the problems now confronting society. Whether these problems involve energy, food, health, materials or environmental quality, the modern chemical engineer is the professional concerned with finding economically and socially acceptable solutions. The program prepares graduates for employment in a great variety of industries including the chemical, petroleum, biochemicals,

pharmaceutical, paper, environmental, fibers, plastics, food, electronics, and consumer product industries. Students may customize their academic program around an industry of their interest by judiciously selecting electives. For example, areas of focus such as polymers, biotechnology, marketing, and environmental chemical engineering are common choices.

The objective of the undergraduate program is to produce chemical engineering graduates who, within five years of completing the BS degree, will be successful in a variety of professional careers, including those outside of traditional chemical engineering fields as evidenced by one or more of the following achievements:

- Sustaining a career as a problem solver in engineering or other fields that require analytical skills
- Professional advancement in positions of increasing leadership and/or responsibility within their chosen career field
- Attainment of an advanced degree or advanced certification leading to a career in engineering or science, business, law, medicine, or academia
- Bettering society through professional or personal service

The curriculum has been developed to meet the department goal and the objectives for the graduates. The curriculum is demanding and a GPA of at least 3.0 is recommended for transfer into the program at the sophomore level. An average GPA of at least 2.00 in all ChE courses attempted is required for continued enrollment in the department. The department has specific grade policies for continuation in the program and for graduation. For further information on these policies, please contact the department.

The chemical engineering curriculum integrates studies in thermodynamics, fluid mechanics, heat transfer, mass transfer, process control, reaction kinetics, plant and process design, verbal and written communications, and reaction kinetics, along with professional ethics and environmental awareness. Students gain hands-on experience with the equipment described in the courses during the summer Unit Operations Laboratory. The laboratory and the senior design courses are recognized as two of the high points in the undergraduate program. Throughout these studies, the student learns the elements of the design of chemical processes and chemical processing equipment. The experience culminates in participation in a national senior-level design contest. The computer is a necessary tool in all the courses and the same software used in industry is used in the design courses.

In addition to the basic undergraduate program outlined here, more sophisticated and specialized programs leading to the M.S. and Ph.D. in chemical engineering also are offered (see [Graduate Catalog](#)).

The department participates in the Cooperative Education Program whereby qualified students may alternate periods of study with periods of professional employment.

## Chemical Engineering Program

A total of 135 semester credits are required for graduation.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

The following are special focus areas students can use as electives. Lists of approved courses for these focus areas are available in the Department of Chemical Engineering.

- Marketing and Chemical Distribution
- Biochemical Engineering
- Polymers

As part of **progress toward a degree**, a student must have a grade of C- or better in all ChE-prefix courses and maintain a minimum in-major GPA of 2.0 or above. If the in-major GPA drops below 2.0 at any time, students will be placed on departmental probation. Students cannot remain on departmental probation for more than two consecutive semesters. In the case that a student has not achieved an in-major 2.0 or better after two semesters, the student is prohibited from registering for any ChE courses for at least one semester and, after that, only with permission of ChE department head. All ChE credits are used to calculate in-major GPA.

**Students who plan to co-op** should talk with with Dr. Goldstein (339 Kelly Hall) of the ChE department.

For additional information about the Chemical Engineering curriculum, please contact the department head.

The Chemical Engineering Department at Virginia Tech is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

## Undergraduate Course Descriptions (CHE)

### 2004: CHEMICAL ENGINEERING SOPHOMORE SEMINAR

Career opportunities and current topics of interest in the Chemical Engineering profession.

Pass/Fail only. (1H,1C)

### 2114: MASS AND ENERGY BALANCES

Stoichiometric and composition relationships, behavior of gases, vapor pressures, solubility, mass balances, recycling operations, energy balances, first law of thermodynamics, thermophysics, thermochemistry, fuels and combustion, application to chemical operations. Pre: (MATH 1206 or MATH 1206H or MATH 1226), (CHEM 1036 or CHEM 1036H or CHEM 1056 or CHEM 1056H).

(3H,3C)

### 2124: CHEMICAL ENGINEERING SIMULATIONS

Many chemical engineering processes lead to sets of linear and nonlinear algebraic equations. This course will focus on numerical methods for solving these types of problems. In addition, techniques for analyzing data to evaluate different models and to obtain model parameters will be developed. Students will learn how to evaluate whether the information provided is sufficient to solve steady-state material balances frequently encountered in process design. Students will be exposed to both mathematical software as well as process modeling software useful for solving process engineering problems and when each should be utilized. Co: MATH 1114 or MATH 2114. Pre: 2114, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). (2H,2C)

### 2164: CHEMICAL ENGINEERING THERMODYNAMICS

First and Second Laws, properties fluids, properties of homogeneous mixtures; phase equilibria, chemical-reaction equilibria. Grade of C- or better required in prerequisite CHE 2114. Pre: 2114.

Co: CHEM 3615. (3H,3C)

### 2984: SPECIAL STUDY

Variable credit course.



### 3015-3016: PROCESS MEASUREMENT & CONTROL

3015: Common process measurements; applications to theory and practice of automatic control of chemical processes; 3016: Design and laboratory practice underlying the automatic computer control of chemical processes. Pre: (MATH 4564 or MATH 4544) for 3015; MATH 4564 or MATH 4544 for 3016. Co: 2124, 3184, 3044 for 3015; 2124 for 3016. 3015: (3H,3C) 3016: (1H,3L,2C)

### 3044: HEAT TRANSFER

One and two dimensional conduction, convection, and diffusion of thermal energy; heat transfer rates, steady state and unsteady state conduction, convection; design of heat exchangers; forced and free convection boiling and condensation. Pre: 2164, 3114, (MATH 4544 or MATH 4564). (2H,2C)

### 3114: FLUID TRANSPORT

Fluid statics, surface tension, fluid dynamics, Newton's Law of viscosity, momentum transport, laminar and turbulent flow, velocity profiles, flow in pipes, flow around objects, non-Newtonian fluids, design of piping systems, pumps and mixing. Pre: 2114, PHYS 2305, (MATH 2204 or MATH 2224). Co: MATH 4564. (3H,3C)

### 3134: SEPARATION PROCESSES

Binary separations and multicomponent separations, distillation, batch distillation, extraction, absorption, McCabe-Thiele and Ponchon Savaret methods, short cut methods, design of plate columns, plate and column efficiencies. Pre: 2114, (CHEM 3615 or CHE 2164). (3H,3C)

### 3144: MASS TRANSFER

Multidimensional molecular diffusion and convection of single and multi-component systems; mass transfer rates; steady state, quasi-steady state and transient mass transfer; effect of reactions on mass transfer; convective mass transfer coefficients; design of stage and continuous gas/liquid contractors, membrane, liquid-liquid and liquid-solid separation processes, artificial kidney and drug delivery systems. Pre: 3114, 2164, (MATH 4544 or MATH 4564). (3H,3C)

### 3184: CHEMICAL REACTOR ANALYSIS AND DESIGN

Power-law rate expressions, kinetic data, rate constants, Arrhenius equation, design of reactors, reactor behavior. Pre: 2164, (MATH 2214 or MATH 2214H or MATH 4544). Co: 3144, 3044. (3H,3C)

### 4014: CHEMICAL ENGINEERING LABORATORY

Practical experience in the planning of experimentation, gathering of experimental data, interpretation of data, and the preparation of written and oral reports. Use of small scale processing equipment. Applications include momentum transfer, heat transfer, mass transfer, and chemical reaction. Use of automatic control and data acquisition. Grade of C- or better in all CHE prefix courses and in-major GPA of 2.0 or better are required. Pre: 3015, 3044, 3134, 3144, 3184, ENGL 3764. (15L,5C)

### 4104: PROCESS MATERIALS

Basics of materials science as it relates to the interest of the chemical engineer. The course emphasizes the three fundamental areas of material science being polymer materials, metallics, and ceramic/inorganic glasses. The general molecular structure property - application behavior of each area will be presented but with a focus when possible on topics related to the field of chemical engineering. Pre: 2164, (CHEM 2535 or CHEM 2565). (3H,3C)

### 4134: CHEMICAL PROCESS MODELING

Mathematical modeling of chemical processes, application of numerical techniques to the solution of equations, use of a programming language to write programs for calling numerical subroutines, numerical solutions of problems resulting in partial differential equations. Pre: 2124, 3114. Co: 3044, 3184, 3144. (2H,2C)

### 4144 (MKTG 4144): BUSINESS AND MARKETING STRATEGIES FOR THE PROCESS INDUSTRIES

Business strategies and industrial marketing concepts, and their application in the chemical, pharmaceutical and related process industries. The course is designed for engineers and other students planning a career in the process industries. Junior standing required. Pre: ECON 2005. (3H,3C)

#### 4185-4186: PROCESS AND PLANT DESIGN

Chemical process synthesis and plant design, economic analysis of alternative processes, process equipment design and specifications, computer-aided process design and simulation, design case studies, application of scientific and engineering knowledge to practical design problems. Grade of C- or better in all CHE prefix courses and in-major GPA of 2.0 or better is required. Pre: 3144, 3134, 3184, 3044, 4014 for 4185; 4185 for 4186. (4H,4C)

#### 4214: INTRODUCTION TO POLYMER MATERIALS

Basics of polymeric materials including description and categorization of macromolecules; characterization; mechanical properties; rubbery, glassy, crystalline, and viscous flow behavior. Pre: CHEM 2536, CHE 2164. (3H,3C)

#### 4224: INTRODUCTION TO POLYMER PROCESSING

Basic principles of momentum and heat transfer applied to the analysis of polymer processing operations. Introduction to polymer rheology. Pre: 3144, 3044. (3H,3C)

#### 4304 (ME 4344): BIOLOGICAL TRANSPORT PHENOMENA

Engineering analysis and predictive modeling of heat and mass transport in biological systems (e.g., tissues, organs, organisms, and biomedical devices). Examination of processes that involve conduction, convection, diffusion, generation/ consumption. Application of analytical and computational methods to solve differential equations that describe unsteady and/or multi-dimensional transport. Topics include oxygen transport, pharmacokinetic analysis, kidney function, blood perfusion, burns, and cryopreservation. Pre: (3114, 3044, 3144) or (ME 3304, ME 3404) or (CHE 3114, CHE 3044, CHE 3144) or (M E 3304, ME 3404). (3H,3C)

#### 4334: INTRO COLLOID INTERFACE SCI

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. Pre: 2164, 3144. (3H,3C)

#### 4544 (BSE 4544): 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. Pre: BSE 3504 or CHE 3144. (3H,3C)

#### 4904: PROJECT AND REPORT

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors course Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Chemistry

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[Undergraduate Course Descriptions \(CHEM\)](#)

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**Chair:** J. M. Tanko

**Associate Chair:** H. Marand

**University Distinguished Professor:** D.G.I. Kingston

**Professors:** P. Carlier, T. D. Crawford, H. C. Dorn, A. R. Esker, F. A. Etzkorn, R. D. Gandour, H. W. Gibson, B. E. Hanson, T. E. Long, H. Marand, J. S. Merola, R. B. Moore, J. R. Morris, J. S. Riffle, J. M. Tanko, and E. F. Valeev

**Research Professor:** S. R. Turner

**Associate Professors:** P. G. Amateis, P. A. Deck, G. L. Long, L. A. Madsen, W. L. Santos, B. M. Tissue, D. Troya, and G. T. Yee

**Assistant Professors:** T. Z. Grove, J. S. Josan, G. G. Liu, J. B. Matson, and A. J. Morris

**Senior Instructor:** M. B. Bump

**Advanced Instructors:** S. M. Arachchige, M. A. Berg, and J. E. Eddleton

**Instructors:** P. L. Durrill, V. K. Long, C. Santos, and C. Slebodnick

**Career Advisor:** G. T. Yee

**Director of Graduate Programs:** J. R. Morris

**Graduate Program Coordinator:** J. Huynh

**Director of Undergraduate Programs:** G. T. Yee

**Undergraduate Program Coordinator:** A. Hawthorne

**Director of General Chemistry:** P. G. Amateis

Web: [www.chem.vt.edu](http://www.chem.vt.edu)

## Overview

The Chemistry Department offers two undergraduate programs: the B.S. in Chemistry and the B.A. in Chemistry. The B.S. curriculum provides the breadth and depth to give graduates a wide choice of career options, including further graduate studies. The Chemistry Department is accredited by the American Chemical Society's Committee on Professional Training and the B.S. degree meets the guidelines for an ACS-certified degree. The B.A. program has fewer required chemistry courses, allowing students to design a chemistry program with more electives to meet a wider set of career goals. The B.A. is often chosen by students who wish to pursue a double major or to take other courses to prepare for professional school, law, or business. Either the B.S. or the B.A. degree is suitable to prepare for high school teaching. The Chemistry Department supports and encourages all chemistry majors to pursue undergraduate research sometime during their degree program.

## Graduate Program

The Department offers M.S. and Ph.D. degrees with specializations in many areas of chemistry. (See the Graduate Catalog for further information.)

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Minor Requirements

The requirements to earn a minor in Chemistry can be found on the specific checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.A. and B.S. in Chemistry can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (CHEM)

### 1015-1016: INTRODUCTION TO CHEMISTRY

For students enrolled in curricula other than science or engineering. Chemical principles applied to material, environmental, and life sciences. (Duplicates 1035-1036.) (3H,3C)

#### 1025-1026: INTRODUCTION TO CHEMISTRY LABORATORY

Accompanies 1015-1016, where lab work is required in a student's curriculum. Must be taken concurrently and in phase with lecture sequence, 1015-1016. In both semesters, experiments illustrate principles covered in lecture. (Duplicates 1045-1046.) Co: 1015 for 1025; 1016 for 1026. (3L,1C)

#### 1035-1036: GENERAL CHEMISTRY

Principles of the science, character of the elements and their more important compounds, solution of chemical problems, and important applications. (Duplicates 1015-1016.) Co: MATH 1025 or MATH 1225. Pre: 1035 or 1055 or 1055H for 1036. (3H,3C)

#### 1045-1046: GENERAL CHEMISTRY LAB

Accompanies 1035-1036. Selected experiments illustrate principles taught in lecture. Prior credit for OR concurrent registration of lecture is required for lab. (Duplicates 1025-1026). Co: 1035 for 1045; 1036 for 1046. (3L,1C)

#### 1055-1056: GENERAL CHEMISTRY FOR CHEMISTRY MAJORS

In depth treatment of chemical bonding, thermodynamics, chemical equilibrium, reaction kinetics, descriptive chemistry of the elements, acid-base chemistry, chemistry of gases, liquids and solids, and other topics. This class is restricted to chemistry and biochemistry majors. Other students may request consent of instructor. Co: MATH 1025 or 1225 and CHEM 1065 for 1055. Co: 1065 for 1055; 1066, 1066 for 1056. (4H,4C)

#### 1055H-1056H: HONORS GENERAL CHEM FOR MAJORS

In depth treatment of chemical bonding, thermodynamics, chemical equilibrium, reaction kinetics, descriptive chemistry of the elements, acid-base chemistry, chemistry of gases, liquids and solids, and other topics. This class is restricted to chemistry and biochemistry majors. Other students may request consent of instructor. Co: MATH 1025 or 1225 and CHEM 1065 for 1055. Co: 1065 for 1055H; 1066, 1066 for 1056H. (4H,4C)

#### 1065-1066: GENERAL CHEMISTRY FOR CHEMISTRY MAJORS LAB

Accompanies 1055-1056. Selected experiments illustrate principles taught in lecture. This class is restricted to chemistry and biochemistry majors. Other students may request consent of instructor. Co: 1055 for 1065; 1056 for 1066. (3L,1C)

#### 2114: ANALYTICAL CHEMISTRY

A first course in analytical chemistry. Topics covered include volumetric and gravimetric analysis, and elementary spectroscopy. Pre: 1036 or 1056 or 1056H. Co: 2124. (3H,3C)

#### 2124: ANALYTICAL CHEMISTRY LABORATORY TECHNIQUES AND PRACTICE

Practical introduction to wet methods of quantitative chemical analysis based on fundamental chemical principles. Prior credit for OR concurrent registration of 2114 lecture is required for 2124 lab. Pre: (1046 or 1066). Co: 2114. (3L,1C)

#### 2154: ANALYTICAL CHEMISTRY FOR CHEMISTRY MAJORS

A one-semester course in analytical chemistry emphasizing the principles of equilibrium with examples from acid-base, complexation, solubility, and redox chemistry. The course also introduces the principles of spectroscopic, electrochemical, and chromatographic instrumentation. Pre: 1036 or 1056 or 1056H. Co: 2164. (4H,4C)

#### 2164: ANALYTICAL CHEMISTRY FOR CHEMISTRY MAJORS LAB

A one-semester laboratory course in analytical chemistry that provides practical training in wet chemical methods, atomic and molecular spectroscopy, electrochemistry, and separations. Pre: 1046 or 1066. Co: 2154. (3L,1C)

#### 2424: DESCRIPTIVE INORGANIC CHEMISTRY

Application of fundamental principles in a systematic study of bonding and reactivity of the elements and their compounds. Pre: 1036 or 1056. (3H,3C)

#### 2514: SURVEY OF ORGANIC CHEMISTRY

Short course in fundamentals of organic chemistry with emphasis on nomenclature, isomerism, and properties of organic compounds. Compounds of importance to biology and biochemistry stressed. (Prior credit for 2535 precludes credit for this course.) One year of Chemistry required. Pre: (1035 or 1055 or 1055H), (1036 or 1056 or 1056H), (1045 or 1065), (1046 or 1066) (3H,3C)

**2535-2536: ORGANIC CHEMISTRY**

Structure, stereochemistry, reactions, and synthesis of organic compounds. Pre: 1036 or 1056 or 1056H or 1036H for 2535; 2535 or (2565 or 2565H) for 2536. (3H,3C)

**2545-2546: ORGANIC CHEMISTRY LABORATORY**

The laboratory accompanies lectures in organic chemistry 2535 and 2536. Pre: 1046 or 1066 for 2545; 2545 for 2546. Co: 2565, 2535 for 2545; 2536 for 2546. (3L,1C)

**2555-2556: ORGANIC SYNTHESIS AND TECHNIQUES LAB**

Synthesis and characterization of organic compounds using modern laboratory techniques. Pre: 2566 for 2555; 2555 for 2556. (6L,2C)

**2565-2566: PRINCIPLES OF ORGANIC CHEMISTRY**

Organic chemistry for chemistry majors. Structure and reactions of organic compounds, with emphasis on fundamental principles, theories, synthesis, and reaction mechanisms. The subject matter partially duplicates that of 2535-2536; no credit will be given for the duplicated courses. Pre: 1036 or 1056 or 1036H or 1056H for 2565; 2565 for 2566. (3H,3C)

**2964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Honors section. Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3615-3616: PHYSICAL CHEMISTRY**

Principles of thermodynamics, kinetics, and quantum mechanics applied to chemical equilibria, reactivity, and structure. Partly duplicates 4615, cannot receive credit for both 3615 and 4615. Pre: (1035 or 1055 or 1055H), (1036 or 1056 or 1056H), PHYS 2306, (MATH 2204 or MATH 2204H or MATH 2224) for 3615; MATH 2214, (CHEM 3615 or CHEM 3615H), (CHEM 3615, MATH 2214 or CHEM 3615H) for 3616. (3H,3C)

**3615H-3616H: HONORS PHYSICAL CHEMISTRY**

Principles of thermodynamics, kinetics, and quantum mechanics applied to chemical equilibria, reactivity, and structure. Partially duplicates 4615, cannot receive credit for both 3615H and 4615. 3615H requires additional work; consult the instructor. Pre: (1035 or 1055 or 1055H), (1036 or 1056 or 1056H), PHYS 2306, (MATH 2204 or MATH 2204H or MATH 2224) for 3615H; MATH 2214, (CHEM 3615 or CHEM 3615H), (CHEM 3615, MATH 2214 or CHEM 3615H) for 3616H. (3H,3C)

**3625-3626: PHYSICAL CHEMISTRY LABORATORY**

Laboratory study of selected physico-chemical principles and methods. Data acquisition, data analysis, and report writing are stressed. Pre: 3615 or 3615H or 4615 for 3625; (3616 or 3616H or 4616), 3625, 4014 for 3626. (3L,1C)

**4014: SURVEY OF CHEMICAL LITERATURE**

Use of the chemical literature as an aid to professional activities. Pre: Junior Major Standing. (1H,1C)

**4074 (MSE 4544): LABORATORY IN POLYMER SCIENCE**

Experimental techniques used in the synthesis of various linear polymers, copolymers, and crosslinked

networks. Determination of polymer molecular weights and molecular weight distribution. Methods used in the thermal, mechanical, and morphological characterization of polymeric systems. Pre: 3616, 4534. (1H,3L,2C)

#### 4114: INSTRUMENTAL ANALYSIS

Principles of instrumental methods including data analysis, phase equilibrium, spectroscopy, and electrochemistry. Applications of modern instrumentation to chemical analyses using chromatography, electrophoresis, atomic and molecular spectroscopy, potentiometry, and voltammetry. Note: Graduate students will not be expected to take the corequisite lab 4124. Pre: (3615 or 3615H), 2154. Co: 4124. (3H,3C)

#### 4114H: HONORS INSTRUMENTAL ANALYSIS

Pre: (3615 or 3615H), 2154. Co: 4124. (3H,3C)

#### 4124: INSTRUMENTAL ANALYSIS LABORATORY

Hands-on experience with modern instrumental methods of analysis. Experiments use spectroscopy, electrochemistry, and separations. Co: 4114. (3L,1C)

#### 4404: PHYSICAL INORGANIC CHEMISTRY

A study of spectroscopic, bonding, and structural properties of inorganic compounds. Pre: (3616 or 3616H), 2424. (3H,3C)

#### 4414: INORGANIC CHEMISTRY LAB

Synthesis and characterization of inorganic compounds using modern laboratory techniques. Pre: 2424, (3616 or 3616H), 4404. Co: 4424, 3616. (6L,2C)

#### 4424 (SBIO 4424): DESCRIPTIVE INORGANIC CHEMISTRY

Structure, properties, and applications of natural polysaccharides. Natural sources and methods of isolation. Synthetic chemistry and important polysaccharide derivatives. Relation of structure and properties to performance in critical applications including pharmaceuticals, coatings, plastics, rheology control, and films. Conversion by chemical and biochemical methods of polysaccharide biomass to fuels and materials. Pre: 2536 or 2566. (3H,3C)

#### 4434: ORGANOMETALLIC CHEMISTRY

Synthesis, structure, properties, and reactivity patterns of main-group and transitionmetal organometallic compounds. Applications of organometallic compounds in chemical synthesis and catalysis. Pre: 2424, 2565, 2566, 4404. (3H,3C)

#### 4514: GREEN CHEMISTRY

Green chemistry applies the principles of prevention of toxic and hazardous waste, and energy efficiency to real world chemical products and processes. Emphasis is on case studies, problem solving, and life cycle analysis. Pre: 2536 or 2566. (3H,3C)

#### 4524: IDENTIFICATION OF ORGANIC COMPOUNDS

Structure determination of organic compounds by spectroscopic methods, with an emphasis on mass spectrometry and nuclear magnetic resonance. Course will emphasize problem-solving skills. I. Pre: (2536 or 2566), (3616 or 3616H or 4616). (3H,3C)

#### 4534: ORGANIC CHEMISTRY OF POLYMERS

Structure, synthesis, and basic characteristics of the major classes of polymerization reactions including step-growth (condensation) and chain growth (addition), free radical, and ionic mechanisms. Pre: 2536 or 2566. (3H,3C)

#### 4554: DRUG CHEMISTRY

Structure, synthesis, and physiological effects of major classes of pharmaceutical agents including CNS depressants and stimulants, analgesics, anesthetics, cardiovascular agents, chemotherapeutic drugs, and oral contraceptives. Pre: 2536 or 2566. (3H,3C)

#### 4615-4616: PHYSICAL CHEMISTRY FOR THE LIFE SCIENCES

Principles of thermodynamics, chemical kinetics, and chemical bonding for students in the life sciences. 4615: Laws and applications of thermodynamics. 4616: Chemical kinetics and chemical bonding including spectroscopy. Partly duplicates 3615, cannot receive credit for 3615 and 4615. Pre: One year of chemistry, physics, and calculus. Pre: (1036 or 1056 or 1056H), (MATH 1026 or MATH 2015 or MATH 1226), (PHYS 2206 or PH YS 2306) for 4615; (1036 or 1056 or 1056H), (MATH 2016 or MATH 2024 or MATH 2224 or MATH 2204 or MATH 2204H or MATH 2214), (PHYS 2206 or PHYS 2306) for 4616. (3H,3C)

#### 4634 (MSE 4534): POLYMER AND SURFACE CHEMISTRY

Physical chemical fundamentals of polymers and surfaces including adhesives and sealants. Pre: 3615 or 4615. (3H,3C)

#### 4734 (CSES 4734) (ENSC 4734): ENVIRONMENTAL SOIL CHEMISTRY

Chemistry of inorganic and organic soil components with emphasis on environmental significance of soil solution-solid phase equilibria, sorption phenomena, ion exchange processes, reaction kinetics, redox reactions, and acidity and salinity processes. Pre: CSES 3114, CSES 3124, (CHEM 2514 or CHEM 2535), (CHEM 2114 or CHEM 2154), (MATH 2016 or MATH 1026 or MATH 1226). (3H,3C)

#### 4754 (CSES 4754) (ENSC 4754): INSTRUMENTAL ANALYSIS FOR AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Theory and principles of common analytical instruments and their applications to agriculture and environmental science research. Topics include atomic absorption and emission spectroscopy, spectrophotometric methods (UV, visible, luminescence, and automation), chromatography, ion-selective electrodes, and microwave digestion. Infrared spectroscopy, atomic ratio and molecular mass spectroscopy, nuclear magnetic resonance will also be included. Provides hands-on experience with modern analytical instruments. Prerequisites or graduate standing required. Pre: (3114, 3124) or (CSES 3114, CSES 3124). (3H,3L,4C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Curriculum for Liberal Education (CLE)

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[Why We Have It](#)

[What Students Will Gain](#)

[Curriculum for Liberal Education \(CLE\) Areas of Study](#)

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### Why We Have It

As a vital component of undergraduate education at Virginia Tech, the Curriculum for Liberal Education (CLE)-required of all undergraduates--empowers our students with a broad base of knowledge and transferable skills. Liberal Education provides students the opportunity for rigorous intellectual encounters with enduring human challenges and important contemporary problems, through wide-ranging exposure to multiple disciplines and ways of knowing.

Through the study of the Sciences, Mathematics, Social Sciences, Histories, Languages and the Arts, the CLE is designed to foster and develop intellectual curiosity and critical thinking; strong analytic, communication, quantitative, and information literacy skills; the capacity for collaboration and creative problem solving; the ability to synthesize and transfer knowledge; intercultural knowledge and understanding; and ethical reasoning and action. The CLE seeks to create the conditions for growing creative and intellectual engagement; civic, personal, and social responsibility; and lifelong learning.

### What Students Will Gain

A liberal education offers 21st century students the foundations of what they need to live and thrive as citizens in a globally engaged democracy, a knowledge-intensive economy, and a society where new ideas and understandings are essential to progress. The success of today's college students in their communities, workplaces, and across their lifetimes depends upon a complex and transferable set of skills and capacities. In their lives and in their careers, our students must be prepared to grasp complex problems, develop a global perspective on the diversity of human experience and knowledge, respond to changing demands, and articulate innovative responses and solutions. Today's students are very likely to change jobs and even careers several times over the course of their lives; and certainly, their roles and responsibilities in their families and communities will change and evolve over their lifetimes as well.

The breadth of a rigorous liberal education combined with the depth of specialized study in the student's primary academic discipline(s)--and evidenced in a demonstrated capacity to adapt and transfer knowledge, skills, and responsibilities to new settings and questions--is essential to the education of the whole student

and sets the stage for a lifetime of learning and growth.

## Curriculum for Liberal Education (CLE) Areas of Study

Because the Curriculum for Liberal Education is a "living curriculum," there will be some changes from year to year. Courses added to the CLE offerings are generally available to students immediately after being approved. Some requirements of the CLE are phased in over a multi-year period. Thus, it is essential that students continue to consult with their advisors. Please visit the CLE homepage at <http://www.cle.prov.vt.edu/> for more information, and for the *Curriculum for Liberal Education Guides*.

### Areas of Study

Area 1: Writing and Discourse	6 Credit Hours
Area 2: Ideas, Cultural Traditions, and Values	6 Credit Hours
Area 3: Society and Human Behavior	6 Credit Hours
Area 4: Scientific Reasoning and Discovery	6 or 8 Credit Hours
Area 5: Quantitative and Symbolic Reasoning	6 Credit Hours
Area 6: Creativity and Aesthetic Experience	1 or 3 Credit Hours
Area 7: Critical Issues in a Global Context	3 Credit Hours
**Students should consult with their advisors about specific college or departmental requirements in these areas.	

### Area 1: Writing and Discourse

6 credit hours (2 courses) selected from approved CLE courses. Students who entered the university prior to Fall 2005 and maintain continuous enrollment until graduation must meet the previous Writing Intensive (WI) requirement.

Area 1 requirements reflect the centrality of discourse in the larger intellectual community. Our first-year writing courses introduce students to the interrelated and shared modes of verbal communication that are distinctive to college life - argument, interpretation, analysis, and metaphor - and whose various usages substantially delineate what it means to become broadly educated. These beginning courses should be thought of as the springboard for further writing and discourse throughout the undergraduate curriculum, especially in the disciplinary concentration.

In order to enable students to meet the aims of both liberal education and of professional preparation, we include writing in many courses throughout the university, even if it may not be the main intellectual capacity emphasized in the course. Students are encouraged to seek out courses that offer frequent opportunities for writing and related forms of discourse, both for the enhanced learning these courses can offer and for their benefit in terms of professional preparation. Many courses in the Curriculum for Liberal Education build upon the writing and oral skills that are the direct goal of Area 1 by including a significant writing component and by encouraging the achievement of excellence in communicating ideas and knowledge.

Formerly, the CLE required writing-intensive (WI) courses to support the development of students' writing skills across the undergraduate career. To better facilitate and broaden this goal, the requirement evolved into a departmental requirement for Visual, Spoken and Written Expression (ViEWS). Development of these competencies may be fostered through specific courses in the major, courses outside the major, and/or previously designated WI courses.

Students may meet the first-year writing requirement in one of three ways:

- By successful completion of the two-semester sequence, ENGL 1105-1106 or COMM 1015-1016
- By successful completion of ENGL 1106 for students who are awarded Advanced Standing (based on standardized test scores and high school class rank) and are placed in ENGL 1106. Advanced Standing

students who complete ENGL 1106 at Virginia Tech in the first enrollment with a C- or better receive Advanced Standing credit for ENGL 1105;

- By successful completion of 1204H for students who meet University Honors Standards or English Department Honors Standards. Honors students who successfully complete ENGL 1204H at Virginia Tech in the first enrollment with a C- or better receive Advanced Standing credit for ENGL 1105.

**Other Information:** Virginia Tech accepts ETS Advanced Placement credit for the Freshman Writing sequence.

## **Area 2: Ideas, Cultural Traditions, and Values**

6 credit hours (2 courses) selected from approved CLE courses.

Every student should be introduced to some of the ideas, cultural traditions, and values that have shaped the human world we now inhabit. An educated person sees the present in connection with the past, and understands that presently prevailing values and meanings derive from the creative thought and action of men and women who have preceded us. A study of influential texts, ideas, representative works of art and technology, and the development of cultural traditions begins to free the student from the superficial fads of the moment and from narrow provincialisms. By examining some of the enduring ideas about human nature and achievement past and present, the individual gains a greater degree of self-knowledge and is better able to formulate worthwhile aims and commitments.

Courses in this curricular area take the human condition and human values as their main focus, while dealing with a range of subject matters: philosophy, literature and communication, history, religion, the arts, and technology. Most of these courses deal with some aspect of Western cultural experience in its numerous varieties. Relatively neglected dimensions of this experience such as the experience of women and minorities will be acknowledged and dealt with, both as an integral aspect of many existing courses and in separate courses which focus directly upon these dimensions. The foreign language courses approved for Area 2 explore the literatures of other countries in their cultural contexts. Moreover, since we are living in an increasingly global cultural context, courses are included that introduce the student to formative non-Western ideas, arts, and traditions as well.

## **Area 3: Society and Human Behavior**

6 credit hours (2 courses) selected from approved CLE courses.

Human beings are not only participants in the world of human culture; we are also observers of it. The cultivation of systematic approaches to the study of humanity is one of the great achievements of the human intellect. Every student should therefore be introduced to the sciences of society and human behavior, a goal that can be accomplished through several avenues: through the study of psychology; through the study of social structures such as government, family, community, or economy; or through more wide-ranging examination of social patterns and processes. Such studies may examine past as well as present, non-Western as well as Western societies.

Courses in this curricular area are best characterized by their methods of study and theoretical frameworks. They look for regularities in human behavior rather than giving primary attention to the unique or non-repeatable aspects of life. When varied human values and allegiances nevertheless make their appearance within these disciplines, they do so more as objects to be investigated than as commitments to be honored.

## **Area 4: Scientific Reasoning and Discovery**

6 credit hours (2 courses) of lecture selected from approved CLE courses. Some majors require 2 credit hours of related laboratory (2 labs).

For many students at Virginia Tech, acquiring detailed knowledge of one or more of the natural sciences is essential. But for all students, a liberal education involves the study of what science is, of how it can be conducted, of what it can and cannot tell us about the world. Without scientific study and the experience offered by a laboratory, students perceive only vaguely how and why science functions as a crucial standard for knowledge and inquiry in modern life. The study of a science engages the student in analysis and

deduction as well as empirical experimentation - that is, in scientific reasoning and discovery.

The impact of the natural sciences and technology on our globally interdependent world is one of the most important realities we face as we enter the 21st century. The science courses in the CLE have a special role in educating students about the critical relevance of scientific knowledge to the potentialities and dilemmas of our natural and social environments.

## **Area 5: Quantitative and Symbolic Reasoning**

6 credit hours (2 courses) selected from approved CLE courses

Like writing, mathematics is essential to intellectual inquiry in many areas. It is a basic language of the natural and social sciences and has become a useful tool for research in the humanities. The technological uses of mathematics and related forms of symbolic analysis are of tremendous significance to human society. Furthermore, the history of quantitative and symbolic reasoning as an intellectual discipline is linked with philosophy, the arts, and other aspects of human culture. Thus, a broad education must include these forms of reasoning, both as skills and as central modes of thought. Mathematics, statistics, and certain areas of computer science and philosophy can all contribute to broadening a student's knowledge of quantitative and symbolic reasoning.

A diagnostic formula and testing procedure has been derived to predict readiness for Engineering/Science Calculus at Virginia Tech. A purpose of MATH 1015 is to serve those students who need further preparation. You can obtain information about the math diagnostic test from your advisor.

Many departments throughout the university have specific math sequence requirements. Be sure to check with your advisor about the requirements for your program.

## **Area 6: Creativity and Aesthetic Experience**

1 or 3 credit hours selected from approved CLE courses. Students in the College of Science and most majors in the College of Liberal Arts and Human Sciences must take one (1) 3-credit hour course. Students should consult with their advisors about specific college or departmental requirements.

The arts contribute significantly both to the experience and the interpretation of human life. Creativity and aesthetic response criss-cross the boundaries among intellectual ideas, the imagination, and actual design. Moreover, the arts are always intimately linked with the material culture of a society - its modes of production and design - as well as with its values and ideas. Thus, the arts can be studied and experienced in a variety of ways: as "high culture," as a means of tracing the history and ideas of particular societies, and as an active process of creative design and expression in many different physical forms. The metaphorical and intuitive thought processes that are essential to making and experiencing works of art are woven into many other human cultural and creative activities. Thus, the arts have an important role to play in broadening our aesthetic and intellectual sensibilities. Most artistic media include a highly public dimension - concerts, exhibitions, performances, publications, public installations, and the built environment - in which the creative works of artists, designers, and their collaborators are accepted or contested as meaningful elements of the larger social fabric. A guided exposure to the arts can provide a valuable framework for continued appreciation of, and participation in, the arts beyond college.

## **Area 7: Critical Issues in a Global Context**

3 credit hours (1 course) selected from approved CLE courses.

Global interdependence is a powerful fact of life as we enter the 21st century. The dilemmas and possibilities humankind faces cannot be effectively addressed by any single culture or group of people acting alone. An awareness of critical issues of the day is thus an essential extension of liberal education and prepares students to respond thoughtfully to the complex world in which they live. As a state institution of higher education, Virginia Tech has a responsibility to prepare students to react creatively and constructively to the social, international, intercultural, and environmental challenges that confront the Commonwealth and the world.

The university requires that undergraduates take at least one course that deals in a substantial way with major issues of critical importance for the larger global society. Courses that satisfy this requirement can be taken in any area of the curriculum, including the major, the Curriculum for Liberal Education, or electives. Students may select from a wide range of courses that focus on major international and intercultural issues in contemporary world affairs, including such areas as politics, the management of conflict, the roles of economic competition and cooperation, demographic issues, and the emerging world order. Many science courses in Area 7 examine global issues associated with environmental decline and restoration. Some engineering courses study the role of technology as a major force in shaping the cultural and economic conditions of human societies. Other courses include comparative or cross-disciplinary examinations of cultures, societies, and belief systems, including those of developing countries. Other courses examine the social and personal implications of cultural, racial, and gender-based differences. Whatever the topical focus of the course, all Area 7 courses utilize interdisciplinary approaches in which a number of relevant factors - historical, ethical, technological, cultural, and/or scientific - are brought to bear on the issues being studied.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Computational Modeling and Data Analytics

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### Overview

[Bachelor of Science in Computational Modeling and Data Analytics](#)

[Satisfactory Progress](#)

[Computer Literacy](#)

[Undergraduate Course Descriptions \(CMDA\)](#)

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**Division Leader:** M. Embree

**Program Manager:** N. Sullivan

**Principle Faculty:** J. Chung, M. Chung, E. de Sturler, X. Deng, S. Gugercin, P. Haskell, L. House, I. Kim, S. Leman, C. North, L. Pillonen, M. Pleimling, N. Ramakrishnan, C. Ribbens, E. Smith, T. Warburton, and L. Zeitsman

Web: [www.science.vt.edu/ais/cmda](http://www.science.vt.edu/ais/cmda)

## Overview

The Computational Modeling and Data Analytics (CMDA) program is a joint effort of the departments of Mathematics, Statistics, and Computer Science. It resides in, and is organized as a division of, the College of Science's Academy of Integrated Science. CMDA courses impart the emerging concepts and techniques from mathematics and statistics, with a decidedly computational approach, that are most in demand by a data-driven world. They prepare students as quantitative scientists ready to engage data and modeling problems wherever they may occur. CMDA is Virginia Tech's Big Data degree.

## Bachelor of Science in Computational Modeling and Data Analytics

All CMDA majors are required to own specified personal computers and software. Consult the division for

details.

A special brochure describing the division and the B.S. program is available from the division's webpage or upon request.

Cooperative Education and internship positions are available in industry and government, offering valuable practical experience. Students participating in such an experience can receive academic credit which will count towards graduation requirements.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Computational Modeling and Data Analytics can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Computer Literacy

Most CMDA courses involve the use of statistical and/or mathematical software, primarily (but not limited to) MATLAB or R. Experience with the software is not expected, but students should have familiarity with either the Windows or Macintosh operating system.

## Undergraduate Course Descriptions (CMDA)

### 2005-2006: INTEGRATED QUANTITATIVE SCIENCES

2005: Integrated topics from quantitative sciences that prepare students for advanced computational modeling and data analytics courses. Topics include: probability and statistics, infinite series, multivariate calculus, linear algebra. 2006: Intermediate linear algebra, regression, differential equations, and model validation. Co: (MATH 1114 or 2114) for 2005. Pre: CS 1114, (MATH 1206 or MATH 1226) for 2005; 2005 for 2006. (6H,6C)

### 2984: SPECIAL STUDY

Variable credit course.

### 3605-3606: MATHEMATICAL MODELING: METHODS AND TOOLS

3605: Mathematical modeling with ordinary differential equations and difference equations. Numerical solution and analysis of ordinary differential equations and difference equations. Stochastic modeling, and numerical solution of stochastic differential equations. 3606: Concepts and techniques from numerical linear algebra, including iterative methods for solving linear systems and least squares problems, and

numerical approaches for solving eigenvalue problems. Ill-posed inverse problems such as parameter estimation, and numerical methods for computing solutions to inverse problems. Numerical optimization. Emphasis on large-scale problems. Pre: 2006 for 3605; 3605 for 3606. (3H,3C)

**3634 (CS 3634): COMPUTER SCIENCE FOUNDATIONS FOR COMPUTATIONAL MODELING & DATA ANALYTICS** Survey of computer science concepts and tools that enable computational science and data analytics. Data structure design and implementation. Analysis of data structure and algorithm performance. Introduction to high-performance computer architectures and parallel computation. Basic operating systems concepts that influence the performance of large-scale computational modeling and data analytics. Software development and software tools for computational modeling. Not for CS major credit. Pre: CS 2114. (3H,3C)

**3654 (CS 3654) (STAT 3654): INTRODUCTORY DATA ANALYTICS & VISUALIZATION** Basic principles and techniques in data analytics; methods for the collection of, storing, accessing, and manipulating standard-size and large datasets; data visualization; and identifying sources of bias. Pre: 2006, CS 1114. (3H,3C)

**4604: INTERMEDIATE TOPICS IN MATHEMATICAL MODELING** Introduction to partial differential equations, including modeling and classification of partial differential equations. Finite difference and finite elements methods for the numerical solution of partial differential equations including function approximation, interpolation, and quadrature. Numerical solution of nonlinear systems of equations. Uncertainty quantification, prediction. Pre: 3606. (3H,3C)

**4654 (CS 4654) (STAT 4654): INTERMEDIATE DATA ANALYTICS AND MACHINE LEARNING** A technical analytics course. Covers supervised and unsupervised learning strategies, including regression, generalized linear models, regularization, dimension reduction methods, tree-based methods for classification, and clustering. Upper-level analytical methods shown in practice: e.g., advanced naive Bayes and neural networks. Pre: 2006. (3H,3C)

**4664 (STAT 4664): COMPUTATIONAL INTENSIVE STOCHASTIC MODELING** Stochastic modeling methods with an emphasis in computing are taught. Select concepts from the classical and Bayesian paradigms are explored to provide multiple perspectives for how to learn from complex, datasets. There is particular focus on nested, spatial, and time series models. Pre: 2006. (3H,3C)

**4864: COMPUTATIONAL MODELING AND DATA ANALYTICS CAPSTONE PROJECT** Capstone research project for Computational Modeling and Data Analytics majors. Cultivates skills including reviewing the literature, creative problem solving, teamwork, critical thinking, and oral, written, and visual communications. Pre: (3605, 3606) or (3654, 4654) or (3634, CS 2114). (3H,3C)

**4964: FIELD STUDY**  
Variable credit course.

**4984: SPECIAL STUDY**  
Variable credit course.

**4994: UNDERGRADUATE RESEARCH**  
Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Communication

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**Head:** Robert E. Denton, Jr.

**Assistant Head and Director of Undergraduate Programs:** Marlene M. Preston

**Director of Graduate Studies:** Beth M. Waggenspack

**W. Thomas Rice Chair:** Robert E. Denton, Jr.

**Professors:** R. E. Denton Jr., W. W. Hopkins, and J. C. Tedesco

**Professor of Practice:** D. F. Cannon

**Associate Professors:** R. L. Holloway, J. D. Ivory, J. A. Kuypers, M. M. Preston, B. M. Waggenspack, and J. B. Mackay

**Assistant Professors:** M. A. Horning, A. H. Ivory, N. J. Logan, N. Mielczarek, M. C. Myers, S. A. Smith, D. J. Tamul, and B. A. Watkins

**Visiting Assistant Professors:** B. W. Howell

**Senior Instructors:** E. W. Stallings

**Advanced Instructors:** D. M. Jenkins, B. Quesenberry, and S. J. Robinson

**Instructors:** D. Conner, C. Hall, H. Shinault, N. Sowder, S. Stinson, E. L. Tydings, and J. Woolly

Web: [www.comm.vt.edu](http://www.comm.vt.edu)

## Overview

The majors in communication, leading to a B.A., allow students to develop a broad understanding of the discipline and specific expertise in either public communication or mass communication. The Department of Communication focuses on strategic, theoretical, and practical application of message creation, delivery, analysis, and criticism in cultural and historical contexts.

Communication majors are prepared to continue their studies in graduate school or immediately apply their skills in various professional settings because of the broad applicability of both the theory to which they are exposed and the competencies they develop. Rooted in a strong liberal arts curriculum, this program prepares students to enter careers in mass media, business, public service, government, or professional specializations, such as law.

## Majors

Students choose one of three majors in COMM in order to specialize in the discipline. Two majors involve the study of public communication: Public Relations and Communication Studies. The other major involves the study of multimedia communication: Multimedia Journalism.

**Public Relations** -- This major emphasizes both skill and management functions of public relations through theoretical and practical applications. Public relations spans media, organizational, corporate, and political contexts and includes investigation and analysis of public relations situations (e.g., crises, successes), message production and campaign planning, writing and presentation, and evaluation of public relations strategies. Public relations permeates many areas of corporate, non-profit, and political careers, so this major provides students a foundation for many different career paths.

**Electronic and Print Journalism (Multimedia)** -- This major prepares students for news media careers in newspapers, magazines, broadcasting and new media. The lines that separate these specialties are blurring as media convergence becomes more nearly the norm. Courses provide both practical skills and theory as they address history, law and ethics, current controversies and opportunities in the changing news media.

**Communication Studies** -- This pre-professional major offers flexible study plans and training necessary to adapt quickly in a rapidly evolving job market. It offers preparation for careers in business, politics, human services, management, law, education, and ministry. Students engage in critical thinking, developing and presenting effective messages, analyzing and solving problems, managing conflict, strategically establishing and maintaining relationships, and responsibly participating in civic life.

Please see [www.comm.vt.edu](http://www.comm.vt.edu) for more information.

## Major Requirements

The curriculum is designed to provide foundational and development courses, major-specific study, and a capstone experience. Students are introduced to concepts early in the undergraduate career, and the curriculum allows them to build knowledge and skills as they work on increasingly complex tasks. They also develop skills in written, spoken, and visual communication across their studies in the major. At the foundational level, students in every option are required to take the same introductory courses. Then students move into one of three majors, and later they come back together in the senior year to work on a capstone experience.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

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## Minor Requirements

A minor in Communication offers a broad exploration of the discipline, helping students to understand disciplinary impacts on society, consideration of audience in communicating messages, and historical and contemporary principles and practice. This understanding can be applied to the academic and professional practice of many other disciplines.

The minor curriculum allows students to study the three main options areas of the discipline: public communication, public relations, and multimedia journalism. The study of public communication centers on skill-building in academic and professional communication skills, such as interpersonal, small group, and/or public speaking.

For the 18-hour minor, students enroll in four foundational courses and choose two upper-level courses from the checksheet. Please see [www.comm.vt.edu](http://www.comm.vt.edu) for details.

## Satisfactory Progress Toward the Degree

University policy requires that students demonstrate their progress toward the degree by meeting minimum requirements. A student will be certified as making satisfactory progress towards a degree by meeting the following requirements:

- Courses: Completion of COMM 2124 no later than the 72nd hour
- Overall GPA: 2.0
- COMM GPA: 2.0

Students who fall below the standard for either the overall GPA or the COMM GPA will have one semester to regain the required GPA standards. A student who fails to make satisfactory progress toward degree after that semester will be blocked from continuing in the Communication major.

## Freshmen and External Transfers into Communication

Incoming freshmen and students enrolled at other institutions should follow directions for application as shown on the Admissions website.

## Internal Transfers into Communication

Students enrolled in other Virginia Tech majors who wish to transfer into Communication must attend an information session and submit an application. Information is available at the Department website: [www.comm.vt.edu](http://www.comm.vt.edu)

## Undergraduate Course Descriptions (COMM)

### 1004: FIRST-SEMESTER EXPERIENCE IN COMMUNICATION

Introduction to areas of research, ethical behaviors, and career paths in the discipline. Consideration of strategies for learning, accessing advising, and locating resources. (1H,1C)

### 1014: INTRODUCTION TO COMMUNICATION STUDIES

Survey of the field of communication studies from the interpersonal to the mass communication levels;

emphasis on development of theories and concepts, social contexts, and message analysis. (3H,3C)

#### 1015-1016: COMMUNICATION SKILLS

Introduction to oral and written communication. 1015: Focus on oral and written communication in interpersonal, small group, and public contexts. Special emphasis on the writing process, listening, interviewing, conflict resolution, critical analysis, and communication through electronic media. 1016: Continued Study in written and oral communication skills for small group and public contexts. Focus on practical applications in research and information gathering, audience analysis and adaptation, message development, and oral and written presentations. May not receive credit for both 1015-1016 and 2004. (3H,3C)

#### 1114: INTRODUCTION TO MEDIA PRODUCTION TECHNOLOGY

Introduction to basic technologies necessary for multimedia production. Attention to aesthetics and technical aspects of production technologies, including creation, editing, and organization of content. (3H,3C)

#### 2004: PUBLIC SPEAKING

Strategies and practice for speaking to specific audiences. Ethical considerations for message preparation, development, presentation, and evaluation. Pre: Sophomore standing. COMM 2004 partially duplicates COMM 1016. (3H,3C)

#### 2014: SPEECH COMMUNICATION

Introductory study of communication messages across various types, including intrapersonal, interpersonal, small group and public. Credit may not be earned for both 1015 and 2014. (3H,3C)

#### 2024: MEDIA WRITING

Writing and information gathering skills including news, features, press releases, and advertising copy for broadcast, print and public relations media. This is a writing intensive (WI) course. Pre: 1014. (3H,3C)

#### 2034: VISUAL MEDIA

An introduction to the visual image and visual thinking applied to photography, video, and film. Sophomore standing required. Pre: 1014. (3H,3C)

#### 2044: PRINCIPLES OF PUBLIC RELATIONS

Principles of public relations practice; public relations in organizations; responsibilities of the public relations practitioner; legal and ethical considerations; role of public relations in society. Sophomore standing required. Pre: 1014. (3H,3C)

#### 2064: THE RHETORICAL TRADITION

Great theories of rhetoric developed throughout the world during the past 2,500 years will be analyzed to demonstrate the dynamic, critical nature of persuasive thought. (3H,3C)

#### 2084: MEDIA AND SOCIETY

An examination of media influence on society. Emphasis on impact of media (such as newspapers, film, social networks, and video games) on audiences and culture. Considerations of the evolution of media, the global and ethical questions posed by the media, and new technology's influence on society. (3H,3C)

#### 2104 (AINS 2104) (HUM 2104): ORAL TRADITIONS AND CULTURE

Examination of the world's great oral traditions, both ancient and contemporary. Emphasis on performance contexts, relationships among multicultural traditions, including American Indian oral traditions, and the relationships among orality, literacy, technology, media, and culture. I (3H,3C)

#### 2124: INTRODUCTION TO COMMUNICATION RESEARCH

Study of approaches to research in the discipline, including identification and analysis of existing research; procedures for conducting and reporting basic research in communication. Pre: 1014, (1016 or ENGL 1106). (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Honors section. Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3014: PUBLIC RELATIONS CASES**

Analysis of contemporary and historic public relations cases. Emphasis on theories, research techniques, planning methods, implementation strategies, evaluation standards, and ethical considerations in public relations programs and campaigns. Pre: 2044, 2124. (3H,3C)

**3034 (HUM 3034) (RLCL 3034): THEORIES OF POPULAR CULTURE**

Relationship of popular culture to communication; ways to classify, analyze, and evaluate popular culture; history of main themes with emphasis on the United States; cultural evolution of the electronic revolution. (3H,3C)

**3044: ORAL COMMUNICATION CENTER PRACTICUM**

Focus on peer pedagogy in a communication center to support development of oral communication competence among students across disciplines. Emphasis on oral communication theory applied to one-on-one support for students' oral presentations. May repeat 1 time. Pre: 1016 or 2004. (1H,1C)

**3064: PERSUASION**

Theoretical foundations of persuasion; techniques of persuasion; contemporary persuasive practice and campaigns; persuasive media strategies. Junior standing required. Pre: 1014. (3H,3C)

**3074: PERSUASIVE PUBLIC SPEAKING**

Advanced critical analysis, preparation and presentation of persuasive speeches. Study of advanced rhetorical principles with emphasis on policy speeches and the use of proofs to convince, strengthen beliefs, and motivate listeners to overt action. Advanced focus on approaches to research, audience analysis, effective organization and extemporaneous delivery. Pre: 1016 or 2004. (3H,3C)

**3084: ADVANCED PUBLIC RELATIONS RESEARCH METHODS**

Analysis and implementation of contemporary academic and professional research tools for public relations. Emphasis on development of research designs, assessment and evaluation of public relations programs and campaigns, and implementation of ethical research practices and standards. Pre: 2044, 2124. (3H,3C)

**3114: VIDEO PRODUCTION: STUDIO**

Producing, directing, and writing live video segments; operating control room and studio equipment including studio camera, video switcher, audio board and the creation of video graphics and written packages. Pre: 2034. (2H,3L,3C)

**3124: INTERPERSONAL COMMUNICATION**

Basic theories and processes of person-to-person communication; interpersonal perception; verbal and nonverbal communication; establishment of relationships in the family and work situation. Junior standing required. (3H,3C)

**3134: PUBLIC ADVOCACY**

Practical reasoning and argumentation about questions of community significance, emphasizing critical thought, rhetorical strategies, and advocacy. Junior standing required. Pre: 2004 or 1016. (3H,3C)

**3144: WRITING AND EDITING FOR PUBLIC RELATIONS**

Advanced writing and editing used to structure and present information in the practice of public relations. Includes message development, message design for delivery through various media, copyediting skills and tools, and strategies for dissemination. Pre: 2024. (3H,3C)

#### 3154: MULTIMEDIA REPORTING

Multimedia news gathering, news writing, audio/visual storytelling, and news judgment for the print and online media. Consideration of professional strategies and standards for reporters, including legal and ethical issues. Pre: 2024, 2034. (3H,3C)

#### 3164: GROUP PROCESSES AND PRESENTATIONS

Study of group theory and its application to a group project, including team dynamics and leadership, conflict resolution, project management, and team presentation strategies. (1H,1C)

#### 3174: ADVANCED MULTIMEDIA REPORTING

Multimedia gathering and writing of complex news, features, and documentary; visual content and news judgment for television, print and online media; techniques of broadcast interviewing and on-camera performance. Considerations of legal and ethical issues related to the reporting of complex news. Pre: 3154. (2H,2L,3C)

#### 3204 (HUM 3204) (RLCL 3204): MULTICULTURAL COMMUNICATION

Exploration of communication in various cultural groups through the medium of performance. Emphasis on understanding cultural differences and similarities in styles of communication, aesthetics, worldviews, and values. (3H,3C)

#### 3214: PROFESSIONAL COMMUNICATION

Theory and contemporary practice of professional oral communication, including interpersonal interaction, small group problem-solving, and public presentations. Emphasis on ethical exchanges in traditional or virtual workshops settings. Pre: 1016 or 2004. (3H,3C)

#### 3244 (PSCI 3244): POLITICAL COMMUNICATION

Distribution of political information; elite-mass communication; alternative models of political communication; communication and telecommunications policy. Pre: PSCI 1014 or PSCI 1024. (3H,3C)

#### 3254 (PSCI 3254): MEDIA AND POLITICS

Explores the role of the mass media in contemporary American politics by examining the development of media as sources of social and political influence. Study of news organizations, their coverage of electoral and issue campaigns, and their impact on candidates and voters. Includes the role of new technologies in campaigns. Pre: Junior Standing. (3H,3C)

#### 3264: COMMUNICATION AND GENDER

Examines how verbal, nonverbal, and visual communication create, sustain, and challenge the meaning of gender and cultural structures and practices. Junior standing. (3H,3C)

#### 3304: TOPICS IN SPORTS COMMUNICATION

Study of the theory and practices related to sports communication in fields such as public or reporting. Topics may include print, broadcast, and online news; college sports information; social media; crisis management; and media relations. May be repeated once with different course content. Junior standing. Pre: 1014. (3H,3C)

#### 3314: SPORTS JOURNALISM

Theory and practice of sports journalism, including strategies for writing and broadcasting sports information. Study of ethics and professional standards. Junior standing required. Pre: 2024, 2034. (3H,3C)

#### 3324: CORPORATE COMMUNICATION

Examines communication theories, strategies and tactics that corporations use in their public relations efforts to reach and influence publics. Prepares students for "in-house" public relations work and familiarizes them with expectations of corporate clients. Introduces students to the important role communication plays within and between for-profit, nonprofit, and government institutions. Emphasis on the influence of corporate culture, ethics and values on communication styles. Pre: 2044. (3H,3C)

#### 3334: PUBLIC RELATIONS AND CORPORATE SOCIAL RESPONSIBILITY

Explores role of communication in corporate social responsibility. Emphasis on the ethical implications of

communicating the need to generate profits with the need to ensure that corporate actions do not harm important stakeholders such as employees, investors, customers, and communities. Pre: 2044. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4014: MEDIA EFFECTS

Impact of mass media on individuals and on society; methods for documentation of media effects; research about effects on various demographic groups such as children, elderly, and minorities; effects of advertising; effects of interactive and time shift technologies. Senior standing required. (3H,3C)

#### 4024: COMMUNICATION LAW

Study freedom of speech and the press how these freedoms apply to the press, public relations, advertising and personal speech. Consideration of First Amendment theories and jurisprudence; related ethical issues. Senior standing. (3H,3C)

#### 4034 (HUM 4034) (RLCL 4034): FUNCTIONS OF POPULAR CULTURE

Popular culture as a humanistic discipline; emphasis on archetypes, formulas, and genres; the function of ideas, images, and icons on the popular imagination. (3H,3C)

#### 4044 (IS 4044): INTERNATIONAL COMMUNICATION

Comparative perspectives on global communication systems; problems with the flow of information; roles of international organizations; mass communication and national development; implications for conflict resolution; selected case studies. Senior standing required. (3H,3C)

#### 4074: ORGANIZATIONAL COMMUNICATION

Role of communication in complex organizations; communication networks, communication and management, message systems, decision-making; relationships between organizational theory and communication. Senior standing required. (3H,3C)

#### 4094: BROADCAST MANAGEMENT

Broadcast management procedures; programming; sales and advertising. Senior standing required. Pre: 3184. (3H,3C)

#### 4114: PHOTOJOURNALISM

Interpretive and creative photography applied to journalism; cameras, films, photography techniques; history of photography as communication; advanced darkroom techniques. Junior standing required. Pre: 2034. (3H,3C)

#### 4134: EDITORIAL WRITING

Development and function of the editorial page; writing of editorials, reviews, and personal columns; examination of role of letters and syndicated columns and cartoons; problems editorial writers face in their jobs and communities. Junior standing required. (3H,3C)

#### 4144: MAGAZINE WRITING

The writing of feature material (as opposed to the reporting of hard news), plus detailed examination of several article types from a wide variety of contemporary magazines and newspapers. Junior standing required. Pre: 2024. (3H,3C)

#### 4154: DIGITAL NEWSROOM

Production of news, including newsroom operations, management, legal and ethical issues, and professionalism. Professional reporting in the newsroom setting and across platforms, including professional writing, interviewing, and photography/videography. Pre: 3174. (1H,3L,3C)

#### 4164: PUBLIC RELATIONS ADMINISTRATION

Public Relations (PR) administration issues related to budgeting, strategy, legal issues, and campaigns in

an organization. Emphasis on PR theory and ethics. Pre: 3014. (3H,3C)

#### 4174: DIGITAL ADVOCACY CAMPAIGNS

Study of advocacy campaigns with digital components. Rhetorical considerations in message construction, analysis of persuasive techniques, ethical standards, and strategies for campaign development. Senior standing required. Pre: (1016 or 2004), 2124. (3H,3C)

#### 4204: COMMUNICATION INTERNSHIP

Placement in a communication industry for practical internship under supervision by a departmental advisor and a professional in the field. May be repeated for credit up to a maximum of 6 hours credit. Junior standing and consent required. Pass/Fail only. Variable credit course.

#### 4224: TOPICS IN MEDIA CRITICISM

Selected topics in media criticism. Offered on demand. Senior standing and consent required. (3H,3C)

#### 4244: TOPICS IN PUBLIC COMMUNICATION

Selected topics in public communication. Offered on demand. Senior standing and consent required. May be repeated with a different topic focus, up to a maximum of 6 credit hours. (3H,3C)

#### 4254: TOPICS IN MEDIA WRITING

Selected topics in media writing; emphasis on critical analysis and writing. Senior standing required. (3H,3C)

#### 4264: SOCIAL MEDIA THEORY & PRACTICE

Study of social media as a professional communication and media tool. Emphasis on foundations in communication theory and contemporary approaches. Pre: 2034. (3H,3C)

#### 4274: BROADCASTING PERFORMANCE

Advanced study of on-air performance for broadcasters. Professionals behaviors and strategies for developing conversational writing, broadcast style, interviewing, reporting, and anchoring. Pre: 3154. (3H,3C)

#### 4304: PUBLIC RELATIONS CAMPAIGNS

Public relations campaign research, planning, implementation and evaluation. Emphasis on applying theory in campaign contexts; executing applied research; setting objectives; developing strategic plans, messages and budgets; carrying out courses of action; and evaluating results. Pre: 2124, 3144, 3014. (3H,3C)

#### 4314: COMMUNICATION AND ISSUES OF DIVERSITY

Study of diversity including issues such as power, race, ethnicity, social class, gender, disability, age, and sexuality as related to communication theory and practice. Pre: Senior standing (3H,3C)

#### 4324: ISSUES IN HEALTH COMMUNICATION

Study of issues related to the theory and practice of health communication, including interpersonal, public, organizational, political, and cultural. Pre: Senior standing. (3H,3C)

#### 4334: COMMUNICATION ETHICS

Discussion of issues related to professional communication ethics; emphasis on recognizing ethical issues, applying theoretical models and critical thinking skills to ethical issues in multimedia journalism, public relations, and communication studies. Includes research on topics related to communication ethics. Pre: Senior standing. (3H,3C)

#### 4364: ISSUE MANAGEMENT IN PUBLIC RELATIONS

Principles of issue management: creation, development, and resolution; role of rhetoric in public policy processes; legal constraints; strategies; social responsibility. Pre: 2044. (3H,3C)

#### 4374: NEW COMMUNICATIONS TECHNOLOGY

Identify recent trends in the innovation of new communications technologies; storage, transmission, and display systems of mediated communication: optical disc, common carriers, telecommunication-computer



linkages, high-definition TV, and virtual reality; information industries and society; markets for new and existing telecommunication services. Junior or senior standing required. Pre: 2084 or 4014. (3H,3C)

**4404: COMMUNICATION CAPSTONE**

In-depth study of a particular issue or theme in communication for majors in communication studies, public relations, or multimedia journalism. Integrates previous work in the discipline, focusing on research and presentation of research. Pre: Senior standing and COMM major. (3H,3C)

**4414: PUBLIC RELATIONS STANDARDS AND PRACTICES**

Addresses complexities of public relations research, planning, implementation, and evaluation required for professional certification. Includes special emphasis on public relations legal and ethical practices. Senior standing. Pre: 4304. (3H,3C)

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Computer Science

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[Program Requirements](#)  
[Opportunities for Majors](#)  
[Information for Non-Majors](#)  
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[Undergraduate Course Descriptions \(CS\)](#)

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**Head:** Calvin J Ribbens

**J. Byron Maupin Professor:** B. Ryder

**Thomas L. Phillips Professor:** N. Ramakrishnan

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**Assistant Professors:** B. Huang, C. Jung, D. Lee, K. Luther, N. Meng, B. A. Prakash, S. Raghvendra, A. Rozovskaya, and F. Servant

**Associate Professor of Practice:** S. Harrison

**Assistant Professor of Practice:** M. Ellis and G. Kulczycki

**Senior Instructors:** N. D. Barnette and W. McQuain

**Academic Advisors:** T. Arthur, L. Bradford, and G. Farris

**Professor Emeritus:** D. C. S. Allison, J. D. Arthur, R. W. Ehrich, J. A. N. Lee, H. R. Hartson, and R. E. Nance

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## The Field of Computer Science

In a contemporary world where every educated person must have some knowledge of computing, the Department of Computer Science offers courses to meet a variety of needs. The department offers a bachelor of science program to prepare specialists in the area of computer science itself, a minor in computer science, and individual courses directed to the needs of non-majors who will be using computers as tools in their chosen careers. The department also offers the M.S. and Ph.D. in computer science (see [Graduate Catalog](#)).

As a major, computer science involves far more than just writing computer programs. It is a technically rigorous field that requires a strong background in mathematics. Computer scientists must be good at problem solving. Their work requires the ability to think abstractly and to represent real-world objects and interactions as symbols that can be manipulated by a computer. The field of computer science is characterized by rapid change and entrepreneurship, with new opportunities emerging every year to improve life in diverse areas such as education, communication, science, commerce and entertainment.

## Accreditation and Program Objectives

The Bachelor of Science degree in Computer Science is accredited by the Computing Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

Part of the accreditation process is a clear statement of program objectives and desired outcomes for graduates. The objective of the computer science program is to provide majors with a balanced breadth and depth of knowledge in computer science that allows them the choice between continuing their education in graduate school and beginning their professional career, and to excel in either environment.

The following program educational objectives describe what graduates of the Virginia Tech Computer Science program are expected to attain within a few years of graduation. Alumni will have:

- Demonstrated technical expertise by applying computer science knowledge and practice to solve challenging problems, whether in employment, graduate study, or individual pursuits;
- Advanced their skills in communication, teamwork, and professional and ethical behavior;
- Demonstrated leadership in their technical or professional pursuits;
- Engaged in post-graduate learning through graduate studies, professional improvement opportunities, or self-study;
- Served society through professional or personal contribution.

Desired outcomes for graduates are organized into the following six areas:

- Foundations of computing: ability to apply knowledge of mathematics and science to carry out analysis of computer science problems and design appropriate solutions; ability to use techniques, skills, and modern software development tools necessary for computing practice.
- Depth of knowledge: ability to identify, formulate, and solve computer science problems; ability to design a computing system to meet desired needs; ability to apply problem-solving strategies to new, unknown, or open-ended situations in computer science.
- Breadth of knowledge: knowledge and understanding of the impact of the many sub-disciplines of computer science.
- Communication skills: ability to function in teams; ability to use written and oral communication skills effectively.
- Professional ethics: understanding of professional and ethical responsibility.

Lifelong learning: recognition of the need for and ability to engage in lifelong learning; ability to acquire and use the ever-changing technical knowledge required of computing professionals.

## Program Requirements

The curriculum in computer science is designed to provide a broad general computer science background that will prepare a student for a professional career as a computer scientist or to continue study at the graduate level. All majors take a set of foundational courses in software design and development, algorithms, and computer organization at the freshmen and sophomore level. Students at the junior and senior level select one theoretical course, four specialty courses and a capstone course according to their individual interests within the field.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Opportunities for Majors

The curriculum in computer science is designed to provide a broad general computer science background that will prepare a student for a professional career as a computer scientist or to continue study at the graduate level. All majors take a set of foundational courses in software design and development, algorithms, and computer organization at the freshman and sophomore level. Students at the junior and senior level select one theoretical course, four specialty courses and a capstone course according to their individual interests within the field. In all, a minimum of 44 credit hours of computer science is required.

The department offers computer science majors the opportunity to enhance their education through a variety of curricular and extracurricular activities. Students who meet the requirements for independent study or undergraduate research can pursue research or individualized study under the direction of a faculty member. Through the honors program, superior students can work toward earning their degree "in honors" or even elect to earn both the bachelor's and master's degrees in an accelerated undergraduate/graduate program. The Cooperative Education Program makes it possible for students to acquire professional experience while pursuing their degree.

The department sponsors chapters of three national computer science organizations: the Association for Computing Machinery (ACM), the national professional organization for computer scientists; the Association for Women in Computing (AWC), which is dedicated to the advancement of women in information technology fields; and Upsilon Pi Epsilon (UPE), the national computer science honor society. Additional recognition of student achievements is made during the annual graduation ceremonies. Among the awards given are the Gorsline award, awarded to a rising senior who has overcome freshman-year academic difficulties and subsequently demonstrated great academic achievement.

## Information for Non-Majors

The department offers a Computer Science minor for non-majors seeking a strong background in computer science. The requirements to earn a minor in Computer Science can be found on its

checksheet by visiting the University Registrar website at [www.registrar.vt.edu/graduation/checksheets/index.html](http://www.registrar.vt.edu/graduation/checksheets/index.html). Minors must meet the same prerequisites as majors. This includes Math 2534 as a co-requisite for CS 2505 and achievement of a "C" (2.0) or better in all CS courses which are prerequisites for subsequent CS courses.

## Computational Facilities

The Department of Computer Science possesses extensive facilities for both instruction and research. There are several undergraduate teaching laboratories and a number of specially equipped research laboratories. These include two large parallel computing clusters and numerous compute and file servers for research and instruction in areas such as animation, digital libraries, software engineering, data mining, bioinformatics and networking. The department also operates extensively equipped laboratories for human-computer Interaction, virtual environments and information visualization. These labs include display walls, state-of-the-art 3D and head-mounted displays, and a 4-wall CAVE immersive theater.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the Curriculum for Liberal Education (see Academics) and toward the degree in computer science.

Satisfactory progress toward the B.S. in Computer Science requires that a Computer Science major must:

- be registered in at least one 3-credit course required in the major during each on-campus semester of the regular academic year;
- maintain a GPA of 2.0 or better in the major;
- not take any CS course required in the major more than twice, including attempts ending in course withdrawal; and
- not repeat more than 3 CS courses required in the major, including attempts ending in course withdrawal.

## Undergraduate Course Descriptions (CS)

### 1014: INTRODUCTION TO COMPUTATIONAL THINKING

An exploration of basic ideas of computational thinking focusing on the perspectives, thought processes, and skills that underlie computational approaches to problem formulation and problem solving. Application of computational tools to investigate complex, large-scale problems in a variety of knowledge domains. Examination of the societal and political implications of computational systems. (3H,3C)

### 1044: INTRODUCTION TO PROGRAMMING IN C

Fundamental concepts underlying software solutions of many problems. Structured data, statement sequencing, logic control, input/output, and functions. The course will be taught using a structured approach to programming. Partially duplicates 1344. (3H,3C)

### 1054: INTRODUCTION TO PROGRAMMING IN JAVA

This course provides an introduction to object oriented programming using the Java language. Fundamental concepts underlying programming and software solutions to many problems. Structured data, statement sequencing, logic control, classes, objects, methods, instantiation of classes, sending messages to objects. (2H,2L,3C)

### 1064: INTRO TO PROGRAMMING IN PYTHON

Developing computational problem solving skills and software solutions to a variety of multimedia, scientific, and engineering problems using the Python programming language. Statement sequencing, conditional program flow, iteration, functional decomposition, and recursion. Simple numeric data types, strings, lists, list comprehensions, sets, and dictionaries. Input/output of file-based data, content obtained from the web, and manipulation of digital images. Basic object-oriented concepts, classes, objects, and

methods. (3H,3C)

#### 1114: INTRODUCTION TO SOFTWARE DESIGN

Fundamental concepts of programming from an object-oriented perspective. Basic software engineering principles and programming skills in a programming language that supports the object-oriented paradigm. Simple data types, control structures, array and string data structures, basic algorithms, testing and debugging. A basic model of the computer as an abstract machine. Modeling and problem-solving skills applicable to programming at this level. Partially duplicates 1054, 1124, and 1705. (2H,2L,3C)

#### 1124: INTRODUCTION TO MEDIA COMPUTATION

This course teaches fundamental manipulations of digital media as an introduction to computer science. Basic software engineering principles and programming skills are taught with a programming language that supports object-oriented programming. Simple data types, control structures, array and string data structures and algorithms, testing and debugging. Partially duplicates 1054 and 1705. (2H,2L,3C)

#### 1604: INTRODUCTION TO THE INTERNET

Introduces the concepts, software, data organization and issues involved with using networked information. Also covers file formats (as applied in networked hypermedia and multimedia sound/video documents), local and global (Internet) network access, electronic mail, transferring files, network news, the World Wide Web, digital libraries, on-line public access catalogs and electronic journals, CD-ROMs and on-line databases, and commercial and other networks. Word processing ability required. (1H,1C)

#### 1944: COMPUTER SCIENCE FIRST YEAR SEMINAR

An introduction to academic and career planning for computer science majors. Pass/Fail only. (1H,1C)

#### 2104: INTRODUCTION TO PROBLEM SOLVING IN COMPUTER SCIENCE

This course introduces the student to a broad range of heuristics for solving problems in a range of settings that are relevant to computation. Emphasis on problem-solving techniques that aid programmers and computer scientists. Heuristics for solving problems "in the small" (classical math and word problems), generating potential solutions to "real-life" problems encountered in the profession, problem solving through computation, and problem solving in teams. Pre: MATH 1205 or MATH 1225 or MATH 1526. (3H,3C)

#### 2114: SOFTWARE DESIGN AND DATA STRUCTURES

A programming-intensive exploration of software design concepts and implementation techniques. Builds on knowledge of fundamental object-oriented programming. Advanced object-oriented software design, algorithm development and analysis, and classic data structures. Includes a team-based, semester-long software project. A grade of C or better is required in CS pre-requisite 1114 or 1124. Pre: 1114 or 1124. (2H,2L,3C)

#### 2304: SELF STUDY IN A PROGRAMMING SYSTEM

Guided self-study in a specific programming system, its syntax and applications; based on prior knowledge of the programming process and experience in programming with some high level language; may be taken three times for credit with different system each time; may be taken only twice for CS major or minor credit; systems to be offered may include FORTRAN, COBOL, C, UNIX, LISP. A grade of C or better required in CS prerequisite 1706. Pre: 2114. (1C)

#### 2505-2506: INTRODUCTION TO COMPUTER ORGANIZATION

An introduction to the design and operation of digital computers. Works up from the logic gate level to combinational and sequential circuits, information representation, computer arithmetic, arithmetic/logic units, control unit design, basic computer organization, relationships between high level programming languages and instruction set architectures. A grade of C or better is required in CS pre-requisite 2114. Pre: 2114 for 2505; 2505, 2114, MATH 2534 for 2506. Co: MATH 2534 for 2505. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3114: DATA STRUCTURES AND ALGORITHMS

Advanced data structures and analysis of data structure and algorithm performance. Sorting, searching, hashing, and advanced tree structures and algorithms. File system organization and access methods. Course projects require advanced problem-solving, design, and implementation skills. A grade of C or better is required in CS prerequisites 2114 and 2505. Pre: 2114, 2505, MATH 2534. (3H,3C)

#### 3214: COMPUTER SYSTEMS

Introduction to computer systems as they are relevant to application programmers today, with emphasis on operating system principles. Operating system design and architectures; processes; threads, synchronization techniques, deadlock; CPU scheduling; system call interfaces, system level I/O and file management; shell programming; separate compilation, loading and linking; inter-process communication (IPC); virtual and physical memory management and garbage collection; network protocols and programming; virtualization; performance analysis and optimization. A grade of C or better is required in CS pre-requisites 2506 and 2114. Pre: 2506, 2114. (3H,3C)

#### 3304: COMPARATIVE LANGUAGES

This course in programming language constructs emphasizes the run-time behavior of programs. The languages are studied from two points of view: (1) the fundamental elements of languages and their inclusion in commercially available systems; and (2) the differences between implementations of common elements in languages. A grade of C or better required in CS prerequisite 3114. Pre: 3114. (3H,3C)

#### 3414 (MATH 3414): NUMERICAL METHODS

Computational methods for numerical solution of non-linear equations, differential equations, approximations, iterations, methods of least squares, and other topics. Partially duplicates Math 4554. A grade of C or better required in CS prerequisite 1044 or 1705 or 1114 or 1124. Pre: (1044 or 1705 or 1114 or 1124), (MATH 2214 or MATH 2214H), (MATH 2224 or MATH 22 24H or MATH 2204 or MATH 2204H). (3H,3C)

#### 3604: PROFESSIONALISM IN COMPUTING

Studies the ethical, social, and professional concerns of the computer science field. Covers the social impact of the computer, implications and effects of computers on society, and the responsibilities of computer professionals in directing the emerging technology. The topics are studied through case studies of reliable, risk-free technologies, and systems that provide user friendly processes. Specific studies are augmented by an overview of the history of computing, interaction with industrial partners and computing professionals, and attention to the legal and ethical responsibilities of professionals. This is a web-supported course, incorporating writing intensive exercises, making extensive use of active learning technologies. A grade of C or better required in CS prerequisite 3114. Pre: 3114, COMM 2004. (3H,3C)

#### 3634 (CMDA 3634): COMPUTER SCIENCE FOUNDATIONS FOR COMPUTATIONAL MODELING & DATA ANALYTICS

Survey of computer science concepts and tools that enable computational science and data analytics. Data structure design and implementation. Analysis of data structure and algorithm performance. Introduction to high-performance computer architectures and parallel computation. Basic operating systems concepts that influence the performance of large-scale computational modeling and data analytics. Software development and software tools for computational modeling. Not for CS major credit. Pre: 2114. (3H,3C)

#### 3654 (CMDA 3654) (STAT 3654): INTRODUCTORY DATA ANALYTICS & VISUALIZATION

Basic principles and techniques in data analytics; methods for the collection of, storing, accessing, and manipulating standard-size and large datasets; data visualization; and identifying sources of bias. Pre: CMDA 2006, CS 1114. (3H,3C)

#### 3704: INTERMEDIATE SOFTWARE DESIGN AND ENGINEERING

Explores the principles of software design in detail, with an emphasis on software engineering aspects.

Includes exposure of software lifecycle activities including design, coding, testing, debugging, and maintenance, highlighting how design affects these activities. Peer reviews, designing for software reuse, CASE tools, and writing software to specifications are also covered. A grade of C or better required in CS prerequisite 3114. Pre: 3114. (3H,3C)

#### 3714: MOBILE SOFTWARE DEVELOPMENT

Technologies and concepts underlying software development for mobile devices (handheld computers). Mobile computing platforms, including architecture, operating system, and programming environment. Software design patterns and structuring for mobile applications. Network-centric mobile software development. Data persistence. Programming for mobile device components such as cameras, recorders, accelerometer, gyroscope and antennas. Location-aware software development. A grade of C or better required in CS prerequisite. Pre: 2114. (3H,3C)

#### 3724: INTRODUCTION TO HUMAN-COMPUTER INTERACTION

Survey of human-computer interaction concepts, theory, and practice. Basic components of human-computer interaction. Interdisciplinary underpinnings. Informed and critical evaluation of computer-based technology. User-oriented perspective, rather than system-oriented, with two thrusts: human (cognitive, social) and technological (input/output, interactions styles, devices). Design guidelines, evaluation methods, participatory design, communication between users and system developers. A grade of C or better required in CS prerequisite 2114. Pre: 2114. (3H,3C)

#### 3744: INTRO GUI PROGRAMMING/GRAPHICS

Design and implementation of object-oriented graphical user interfaces (GUI) and two-dimensional computer graphics systems. Implementation methodologies including callbacks, handlers, event listeners, design patterns, layout managers, and architectural models. Mathematical foundations of computer graphics applied to fundamental algorithms for clipping, scan conversion, affine and convex linear transformations, projections, viewing, structuring, and modeling. A grade of C or better is required in CS pre-requisite 2114. Pre: 2114, (MATH 1114 or MATH 1114H or MATH 2114 or MATH 2114H), (MATH 1224 or MATH 1 224H or MATH 2204 or MATH 2204H). (3H,3C)

#### 3824: INTRODUCTION TO COMPUTATIONAL BIOLOGY AND BIOINFORMATICS

Introduction to computational biology and bioinformatics (CBB) through hands-on learning experiences. Emphasis on problem solving in CBB. Breadth of topics covering structural bioinformatics; modeling and simulation of biological networks; computational sequence analysis; algorithms for reconstructing phylogenies; computational systems biology; and data mining algorithms. Pre-requisite: Grade of C or better in CS 3114. Pre: 3114. (3H,3C)

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4104: DATA AND ALGORITHM ANALYSIS

Data structures and algorithms from an analytical perspective. Theoretical analysis of algorithm efficiency. Comparing algorithms with respect to space and run-time requirements. Analytical methods for describing theoretical and practical bounds on performance. Constraints affecting problem solvability. A grade of C or better is required in CS prerequisite 3114. Pre: 3114, (MATH 3034 or MATH 3134). (3H,3C)

#### 4114: INTRODUCTION TO FORMAL LANGUAGES AND AUTOMATA THEORY

The course presents a study of formal languages and the correspondence between language classes and the automata that recognize them. Formal definitions of grammars and acceptors, deterministic and nondeterministic systems, grammar ambiguity, finite state and push-down automata, and normal forms will be discussed. Pre: MATH 3134 or MATH 3034. (3H,3C)

#### 4124: THEORY OF COMPUTATION

Theoretical analysis of the computational process; fundamental concepts such as abstract programs, classes of computational machines and their equivalence, recursive function theory, unsolvable problems, Church's thesis, Kleene's theorem, program equivalence, and generability, acceptability, decidability will be covered. Pre: MATH 3134 or MATH 3034. (3H,3C)



#### 4204: COMPUTER GRAPHICS

Hardware and software techniques for the display of graphical information. 2D and 3D geometry and transformations, clipping and windowing, software systems. Interactive graphics, shading, hidden surface elimination, perspective depth. Modeling and realism. A grade of C or better required in CS prerequisite 3114 and 3744. Pre: 3114, 3744. (3H,3C)

#### 4214: SIMULATION AND MODELING

Overview of discrete-event digital computer simulation and modeling. Fundamentals of model development, Monte Carlo simulation, the life cycle of a simulation study, input and output data analysis, world views and time control, random number and variate generation, credibility assessment of simulation results, simulation languages, applications of simulation using the General Purpose Simulation System (GPSS). A grade of C or better required in CS prerequisite 2114. Pre: 2114. (3H,3C)

#### 4234: PARALLEL COMPUTATION

Survey of parallel computer architectures, models of parallel computation, and interconnection networks. Parallel algorithm development and analysis. Programming paradigms and languages for parallel computation. Example applications. Performance measurement and evaluation. A grade of C or better required in CS prerequisite 3214. Pre: 3214. (3H,3C)

#### 4244: INTERNET SOFTWARE DEVELOPMENT

Key technology underlying the World-Wide Web. Web architecture, including client and server design, network protocols, and related standards. Static and dynamic content, caching, state management, fault tolerance, error handling. Programming systems and abstractions, e.g., sockets, remote procedures, Web services, frameworks and component models. Document representations and processing. Security. Entrepreneurial issues and emerging technologies. A grade of C or better required in CS 3214 prerequisite. Pre: 3214. (3H,3C)

#### 4254: COMPUTER NETWORK ARCHITECTURE AND PROGRAMMING

Introduction to computer network architecture, and methods for programming network services and applications (e.g. DNS, Email and MIME, http, SNMP, multimedia). Wired, wireless, and satellite network architectures. OSI protocol model, with an emphasis on upper layers. Congestion control, quality of service, routing. Internet protocol suite (e.g. IP, TCP, ARP, RARP). Server design (e.g. connectionless, concurrent). Network programming abstractions (e.g. XDR, remote procedure calls, sockets, DCOM). Case studies (e.g. TELNET). A grade of C or better required in CS prerequisite 3214. Pre: 3214. (3H,3C)

#### 4264: PRINCIPLES OF COMPUTER SECURITY

Survey of computer problems and fundamental computer security design principles and models for software systems. Cryptographic models and methods. Modern cyber security techniques for robust computer operating systems, software, web applications, large-scale networks and data protection. Privacy models and techniques. Contemporary computer and network security examples. A grade of C or better is required in prerequisites. Pre: 3214 or (ECE 2500, ECE 3574). (3H,3C)

#### 4284: SYSTEMS & NETWORKING CAPSTONE

Advanced topics in computer systems & networking, e.g. distributed and parallel processing, emerging architectures, novel systems management & networking design, fault-tolerance, and robust and secure data management. Team-based approach to solving open-ended computer systems & networking problems. Designing, implementing and documenting advanced computer/networking systems. A grade of C or better required in CS prerequisites. Pre: 3114, 3214. (3H,3C)

#### 4304: COMPILER DESIGN AND IMPLEMENTATION

This course includes the theory, the design, and the implementation of a large language translator system. Lexical analysis, syntactic analysis, code generation, and optimization are emphasized. A grade of C or better required in CS prerequisite 3214. Pre: 3214. (3H,3C)

#### 4414 (MATH 4414): ISSUES IN SCIENTIFIC COMPUTING

Theory and techniques of modern computational mathematics, computing environments, computational linear algebra, optimization, approximation, parameter identification, finite difference and finite element methods and symbolic computation. Project-oriented course; modeling and analysis of physical systems

using state-of-the-art software and packaged subroutines. Pre: (MATH 2214 or MATH 2214H or MATH 2406H or CMDA 2006), MATH 3214, (CS 2114 or MATH 3054). (2H,3L,3C)

#### 4504 (ECE 4504): COMPUTER ORGANIZATION

Overview of the structure, elements and analysis of modern enterprise computers. Performance evaluation of commercial computing. Past and emerging technology trends. Impact of parallelism at multiple levels of computer architecture. Memory and storage. Fundamental computer system descriptions, Amdahl's Law, Flynn's Taxonomy. A grade of C or better required in prerequisites. Pre: ECE 2504 or CS 3214. (3H,3C)

#### 4570 (ECE 4570): WIRELESS NETWORKS AND MOBILE SYSTEMS

Multidisciplinary, project-oriented design course that considers aspects of wireless and mobile systems including wireless networks and link protocols, mobile networking including support for the Internet Protocol suite, mobile middleware, and mobile applications. Students complete multiple experiments and design projects. Pre: 4254 or ECE 4564. (3H,3C)

#### 4604: INTRODUCTION TO DATA BASE MANAGEMENT SYSTEMS

Emphasis on introduction of the basic data base models, corresponding logical and physical data structures, comparisons of models, logical data design, and data base usage. Terminology, historical evolution, relationships, implementation, data base personnel, future trends, applications, performance considerations, data integrity. Senior standing required. A grade of C or better required in CS prerequisite 3114. Pre: 3114. (3H,3C)

#### 4624: MULTIMEDIA, HYPERTEXT AND INFORMATION ACCESS

Introduces the architectures, concepts, data, hardware, methods, models, software, standards, structures, technologies, and issues involved with: networked multimedia information and systems, hypertext and hypermedia, networked information videoconferencing, authoring/electronic publishing, and information access. Coverage includes how to capture, represent, link, store, compress, browse, search, retrieve, manipulate, interact with, synchronize, perform, and present: text, drawings, still images, animations, audio, video, and their combinations (including in digital libraries). Pre: 3114. (3H,3C)

#### 4634: DESIGN OF INFORMATION

Survey of the higher-order properties that allow data to become information, that is, to inform people. The course focuses on the analysis of user needs, user comprehension and local semantics; the design of information organization; and the design of information display appropriate to use and setting. A grade of C or better is required in CS prerequisites 3114 and 3724. Pre: 3114, 3724. (3H,3C)

#### 4644: CREATIVE COMPUTING STUDIO

Capstone computer science course at the intersection of arts and technology. Intensive immersion in different approaches to digital arts such as game design, interactive art, digital music, and immersive virtual reality. Students work in teams to conduct an end-to-end integrative design project. A grade of C or better is required in prerequisite CS 3724. Pre: 3724. (3H,3C)

#### 4654 (CMDA 4654) (STAT 4654): INTERMEDIATE DATA ANALYTICS AND MACHINE LEARNING

A technical analytics course. Covers supervised and unsupervised learning strategies, including regression, generalized linear models, regularizations, dimension reduction methods, tree-based methods for classification, and clustering. Upper-level analytical methods shown in practice: e.g., advanced naive Bayes and neural networks. Pre: CMDA 2006. (3H,3C)

#### 4704: SOFTWARE ENGINEERING CAPSTONE

Senior project course integrating software engineering knowledge and skills acquired in previous courses. Team-based approach to problem formulation, requirements engineering, architecture, design, implementation, integration, documentation and delivery of software system that solves a real-world problem. Pre: A grade of C or better in CS 3704. Pre: 3704. (3H,3C)

#### 4784: HUMAN-COMPUTER INTERACTION CAPSTONE

Advanced, project-based course in Human-Computer Interaction. Team-based, end-to-end, integrative interface design project drawn from area of expertise in the department, e.g., virtual reality, augmented

reality, embodied cognition, visualization, semiotic engineering, game design, personal information management, mobile computing, design tools, educational technology, and digital democracy. Pre-requisite: Senior Standing required. A grade of C or better is required in CS pre-requisite 3724 and 3744 Pre: 3724, 3744. (3H,3C)

#### 4804: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Overview of the areas of problem solving, game playing, and computer vision. Search trees and/or graphs, game trees, block world vision, syntactic pattern recognition, object matching, natural language, and robotics. Senior standing required. A grade of C or better required in CS prerequisite 3114. Pre: 3114. (3H,3C)

#### 4824 (ECE 4424): MACHINE LEARNING

Algorithms and principles involved in machine learning; focus on perception problems arising in computer vision, natural language processing and robotics; fundamentals of representing uncertainty, learning from data, supervised learning, ensemble methods, unsupervised learning, structured models, learning theory and reinforcement learning; design and analysis of machine perception systems; design and implementation of a technical project applied to real-world datasets (images, text, robotics). A grade of C- or better in prerequisites. Pre: ECE 2574, (STAT 4604 or STAT 4705 or STAT 4714). (3H,3C)

#### 4884: COMPUTATIONAL BIOLOGY & BIOINFORMATICS CAPSTONE

Advanced topics in computational biology and bioinformatics (CBB). Team-based approach to solving open-ended problems in CBB. Projects drawn from areas of expertise in the department, e.g., algorithms for CBB, computational models for biological systems, analysis of structure-function relationships in biomolecules, genomic data analysis and data mining, computational genomics, systems biology. Design, implementation, documentation and presentation of solutions. A grade of C or better required in CS prerequisite 3824. Pre: 3824. (3H,3C)

#### 4944: SEMINAR

Pass/Fail only. (1H,1C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Crop and Soil Environmental Sciences

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**Head:** Thomas Thompson

**Thomas B. Hutcheson, Jr. Professor:** W. L. Daniels

**W. G. Wysor Professor:** C. Griffey

**Professors:** A. O. Abaye, M. J. Eick, E. H. Ervin, G. K. Evanylo, J. M. Goatley Jr, C. Hagedorn, S. C. Hodges, M. A. Saghai Maroof, and C. E. Zipper

**Associate Professors:** D. F. Berry, J. H. Fike, J. M. Galbraith, D. Holshouser, R. O. Maguire, C. D. Teutsch, W. E. Thomason, B. F. Tracy, C. A. Wilkinson, and K. Xia

**Assistant Professors:** B. D. Badgley, W. H. Frame, T. Fukao, M. S. Reiter, M. Steele, R. Stewart, and B. Zhang

**Affiliate Professor:** A. Pereira

**Adjunct Professors:** R. F. Follett, J. E. Perry III, P. J. Thomas, R. W. Tiner, and M. J. Vepraskas

**Undergraduate Program Director:** Benjamin Tracy (231.8259, [bftracy@vt.edu](mailto:bftracy@vt.edu))

Web: [www.cses.vt.edu](http://www.cses.vt.edu)

## Overview

With the world's population now approaching 7 billion people, and expected to exceed 9 billion within 30 to 40 years, the demand for food is expected to double. Therefore, our ability to sustainably produce plants for food and aesthetic purposes is more crucial now than ever before. If you want to become a scientist with the skills and knowledge to grow crops or turfgrass to provide for human needs and improve environmental quality, then the Crop and Soil Sciences major at Virginia Tech is for you! In the CSS program, students learn the fundamentals of plant science and improvement, and soil and environmental stewardship for feeding the world, protecting the environment, and producing quality turfgrass. As a student majoring in Crop and Soil Sciences, you can count on quality academic programs relevant for today and tomorrow, opportunities for involvement and experience, and individual and personal attention from our award-winning faculty and staff. Our programs offer the rigor, flexibility, and practical knowledge that will help you succeed regardless of the path you choose. You will learn the fundamentals of soil, plant, and environmental sciences to prepare you for your career.

## Agronomy Option

Students in this option concentrate on the biology and increasingly complex technology of food, feed, fuel, and fiber production. Graduates typically move into farming or into sales, consulting, and managerial positions that directly and indirectly support agricultural production, a most vital component of the world's economy.

## Crop Genetics and Breeding Option

Producing better quality and higher yielding crops has been a long-standing objective of crop breeders. New techniques of genetic engineering are now being brought to bear on crop improvement. Students in this option learn the newest methods of molecular biology and are well prepared for careers in research and industry.

## International Agriculture Option

The world's ever-expanding population must be fed; at the same time, we must be good stewards of the Earth's resources. Many countries have not been able to bring food production and resource conservation into balance. Students in the International Agriculture option are interested in finding simultaneous solutions to these concerns. Employment opportunities exist with various private and public agencies.

## Turfgrass Management Option

Using basic principles of the natural sciences and agricultural technology, turf managers have skills that make them highly employable in golf-course management, athletic and recreational fields, lawn maintenance services, the landscaping industry, and sod production.

## Requirements for a Major

All the curricula for the various options contain a core of courses to assist the student in developing knowledge and ability in basic sciences (biology and chemistry), computational skills (mathematics and statistics), communication skills (both writing and speaking), as well as crop, soil, and environmental sciences. A list of courses specified for each option may be obtained upon request from the department or at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree

requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Requirements for a Minor

The department offers minors in crop and soil environmental sciences, turfgrass management, environmental science and wetland science. The requirements for each include CSES/ENSC 3114 and 3124 (or 3134) and 15 or 16 more credit hours selected from courses from within and outside the department. Consult the department office (238-C Smyth) or web site (<http://www.registrar.vt.edu/graduation/checksheets/index.html>) for more information on a minor.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the specific degree can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Opportunities to Excel

Students with outstanding records can qualify for the Honors Program and graduate "in honors" in crop and soil environmental sciences. Other opportunities for personal and professional growth and for recognition include department-sponsored agronomy and turf clubs, membership in Alpha Zeta and Gamma Sigma Delta or other honoraries, and several scholarships. B.S. graduates are certifiable in the professional registry of the American Society of Agronomy.

Graduate courses and research opportunities lead to M.S. and Ph.D. specializations in the crop, soil, and environmental sciences. (See the [Graduate Catalog](#) for more information.)

## Undergraduate Course Descriptions (CSES)

### 2434: CROP EVALUATION

Identification of more than 200 crops, weeds, seeds and crop diseases. Seed testing for purity according to the rules of the Association of Official Seed Analysts. Crops graded according to the official USDA grain grading standards. (6L,2C)

### 2444: AGRONOMIC CROPS

An introduction to crop production in Virginia, presenting basic climatic, crop, and soil characteristics and their relation to cropping systems. Introduces basic mechanical, chemical, and managerial tools of crop production and examines feed quality and seed and forage storage. (3H,3C)

### 2564: TURFGRASS MANAGEMENT

Growth, development, adaptation, and selection of the major turfgrass species. Principles of establishment, mowing, nutrition, irrigation, cultivation, and pest control of lawns and utility turfs. Co: BIOL

1105. (2H,3L,3C)

2964: FIELD STUDY  
Variable credit course.

2974: INDEPENDENT STUDY  
Variable credit course.

2984: SPECIAL STUDY  
Variable credit course.

2994: UNDERGRADUATE RESEARCH  
Variable credit course.

3114 (ENSC 3114) (GEOS 3614): SOILS

Characterization of soils as a natural resource emphasizing their physical, chemical, mineralogical, and biological properties in relation to nutrient availability, fertilization, plant growth, land-use management, waste application, soil and water quality, and food production. For CSES, ENSC, and related plant-and earth-science majors. Partially duplicates 3134. Pre: CHEM 1036. Co: 3124. (3H,3C)

3124 (ENSC 3124) (GEOS 3624): SOILS LABORATORY

Parent materials, morphology, physical, chemical, and biological properties of soils and related soil management and land use practices will be studied in field and lab. Partially duplicates 3134. Co: 3114. (3L,1C)

3134 (ENSC 3134): SOILS IN THE LANDSCAPE

A study of soils as functional landscape components, emphasizing their physical, chemical, mineralogical, and biological properties in relation to plant growth, nutrient availability, land-use management, and soil and water quality. Primarily for FOR/FIW, LAR, and other plant/earth science related majors. May not be taken by CSES or ENSC majors. Partially duplicates 3114 and 3124. Pre: one year of introductory CHEM or BIOL or GEOS. (2H,3L,3C)

3144: SOIL DESCRIPTION AND INTERPRETATION

Describing, classifying, evaluating, and interpreting soil and site properties in the class and field. Local field trips supplement lecture and laboratory studies. Required for students interested in attending soil judging contests. Co: 3124, 3114. (1H,6L,3C)

3304 (GEOG 3304) (GEOS 3304): GEOMORPHOLOGY

Examines the variety of landforms that exist at the earth's surface. Detailed investigation of major processes operating at the earth's surface including: tectonic, weathering, fluvial, coastal, eolian, and glacial processes. Field excursion. Pre: GEOG 1104 or GEOS 1004 or GEOS 2104. (3H,3C)

3444 (HORT 3444): WORLD CROPS AND CROPPING SYSTEMS

An introduction to world crops, their primary regions of production, the factors that determine where they are grown, and their economic importance, and how they are used in the human diet. Describes the various factors that can be managed to improve crop yields. Examines present and potential systems of farming for improved crop production in the major climatic and soil ecosystems of the world. Provides an opportunity to taste foods made in traditional and non-traditional ways from the crops hence from field to fork. Junior standing required. (2H,3L,3C)

3564: GOLF AND SPORTS TURF MANAGEMENT

Principles of turfgrass science and culture required for successful establishment and management of intensely utilized fine golf and sports turf surfaces. Pre: 2564. (3H,3C)

3614 (ENSC 3614): SOIL PHYSICAL AND HYDROLOGICAL PROPERTIES

Soil physical and mechanical properties and the physical processes controlling soil water retention and flow in agronomic and natural settings. Grain size distribution, weight-volume relationships, specific surface, electrical charge density, consistency, stress, compaction, rainfall runoff, water retention, steady/non-steady water flow in saturated/unsaturated soil, infiltration, bare soil evaporation, and soil

water balance. Pre: (3114, 3124) or (GEOS 3614, GEOS 3624). (3H,3C)

#### 3634 (ENSC 3634): PHYSICS OF POLLUTION

Physical processes that control the fate of pollutants in our land, air, and water resources. Types and sources of pollutants, physical processes in the soil-water-atmosphere continuum controlling the dispersion and deposition of pollutants, the movement of pollutants, including radionuclides, by surface and subsurface water flow in soils, and physics of disturbed soils. Pre: 3114, PHYS 2205, (MATH 2016 or MATH 2024). (3H,3C)

#### 3644 (ENSC 3644): PLANT MATERIALS FOR ENVIRONMENTAL RESTORATION

Overview of ecological principles related to revegetation and restoration of disturbed sites. Function and species requirements of plants in stabilizing disturbed areas including mines, rights-of-way, constructed wetlands, and for the remediation of contaminated soils. Pre: BIOL 1106. Co: 3114. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4134 (ENSC 4134): SOIL GENESIS AND CLASSIFICATION

Formation of soils across landscapes, soil-forming factors and processes, applied soil geology/geomorphology, applied soil biochemistry, soil hydrology, diagnostic horizons and characteristics used in Soil Taxonomy; soil classification and mapping. Three outdoor lectures and one 3-day field trip are mandatory. Pre: (3114, 3124) or (ENSC 3114, ENSC 3124) or (GEOS 3614, GEOS 3624) or CSES 3134 or ENSC 3134. (3H,3C)

#### 4144: PLANT BREEDING AND GENETICS

Genetic variation in plants and its importance in plant breeding, and comparisons of theories and procedures in breeding of self-pollinated versus cross-pollinated plants. (2H,3L,3C)

#### 4164 (BIOL 4164) (ENSC 4164): ENVIRONMENTAL MICROBIOLOGY

Ecology, physiology, and diversity of soil and aquatic microorganisms; incorporates the significance of these topics within the context of environmental applications such as bioremediation, wastewater treatment, control of plant-pathogens in agriculture, and pollution abatement in natural systems. The laboratory portion of the course will stress methodology development, isolation and characterization of microorganisms from natural and engineered systems, and examination of the roles of microorganisms in biogeochemical cycling. Pre: BIOL 2604. (2H,3L,3C)

#### 4174: SOIL EVALUATION AND SAMPLING

Naming, describing, classifying, sampling, and interpreting soil and site properties in the field to assess environmental impacts and suitability under specific land use scenarios. Selecting and evaluating sites of representative soil resources across the landscape using accepted professional protocols, simulating workplace responsibilities and performance. Local and regional field trips and sampling projects provide professional skill development evaluated by practitioners and potential employers. Pre: 3114 or 3144. (2H,3L,3C)

#### 4214: SOIL FERTILITY AND MANAGEMENT

Soil productivity and nutrients required for crop growth; fertilizer sources and nutrient reactions in soil; methods of fertilizer nutrient placement in major tillage systems; and interpretation of soil tests and plant analyses for determining crop nutrient requirements. Pre: 3114 or 3134. (3H,3C)

#### 4314 (ENSC 4314): WATER QUALITY

Provide comprehensive information on the physical, chemical, biological, and anthropogenic factors affecting water quality, fate and transport of contaminants in water, water quality assessment and management, and current water quality policies. Pre: (ENSC 3604 or BIOL 4004), (MATH 2015 or MATH 1026), (BIOL 1105 or BIOL 1106), (CHEM 1035 or CHEM 1036). (3H,3C)

#### 4324 (ENSC 4324): WATER QUALITY LABORATORY

Teach students a variety of laboratory chemical and biological techniques for water quality analysis. Complementary to ENSC/CSES 4314. Pre: CHEM 1046. Co: 4314, ENSC 4314. (3L,1C)



#### 4334 (FREC 4334): PRINCIPLES AND PRACTICE OF AGROFORESTRY

Biological, social, economic, and technical aspects of agroforestry, training and technology transfer techniques, and application of forestry and agriculture principles. Roles of animals and fish, trees, and agricultural crops in agroforestry systems. Community involvement in planning and implementation of agroforestry projects. (3H,3C)

#### 4344: CROP PHYSIOLOGY AND ECOLOGY

Developmental and ecological processes important in cropping situations: seed physiology, root and canopy development, flowering, water stress, energy flow, competition; emphasis on physiological adaptations, limitations to yield, and yield-optimizing strategies. (3H,3C)

#### 4354: ADVANCED AGRONOMIC CROPS

Survey of major agronomic crops grown in the Eastern US and their production including: corn, soybean, wheat, barley, cotton, peanut, tobacco and alfalfa. Covers impact of environmental conditions and management on crops, resource requirements for productivity, and effects on soil resources. (3H,3C)

#### 4444 (ENSC 4444): MANAGED ECOSYSTEMS, ECOSYSTEM SERVICES, AND SUSTAINABILITY

Description and interactions of climate, soils, and organisms within intensively managed ecosystems used to produce food, fiber, bioenergy, fresh water, recreation, cultural, and other ecosystems services essential for human well-being. Ecological concepts applied to agricultural, grassland, and urban/turf ecosystems. Ecologically-based principles for sustainably managed ecosystems. Regional and global significance of managed ecosystems in context of sustainable food systems, and the Millennium Ecosystem Assessment. Pre-Requisite: Junior or Senior Standing required. Pre: 3114, 3124. (3H,3C)

#### 4544: FORAGE CROP ECOLOGY

Species adaptation interrelated with soil, climatic, and biotic factors as associated with establishment, production, utilization, and nutritional value of forages. (3H,3C)

#### 4594: SOIL AND GROUNDWATER POLLUTION

Application of mathematical models for chemical movement in soils and groundwater to evaluate soil and groundwater pollutant behavior; discussion of pollution remediation technologies; design of subsurface monitoring networks; case studies in soil and groundwater pollution; applications to landfills, waste spills, septic drainfields, pesticide/fertilizer leaching, and other problems of environmental concern. Pre: (MATH 2224 or MATH 2204 or MATH 2204H), (GEOL 4114 or CEE 4314). (3H,3C)

#### 4644: LAND-BASED SYSTEMS FOR WASTE TREATMENT

Soils as a medium for waste treatment; potential for environmental degradation from biologicals and chemicals added to soils; development of land-based treatment and utilization systems for solid and liquid wastes; issues and concerns relating to large-scale applications of municipal and industrial wastes to land. (3H,3C)

#### 4734 (CHEM 4734) (ENSC 4734): ENVIRONMENTAL SOIL CHEMISTRY

Chemistry of inorganic and organic soil components with emphasis on environmental significance of soil solution-solid phase equilibria, sorption phenomena, ion exchange processes, reaction kinetics, redox reactions, and acidity and salinity processes. Pre: 2114, 3124, CHEM 2514 or CHEM 2535, CHEM 2114, (MATH 2015 or MATH 1026). (3H,3C)

#### 4754 (CHEM 4754) (ENSC 4754): INSTRUMENTAL ANALYSIS FOR AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Theory and principles of common analytical instruments and their applications to agriculture and environmental science research. Topics include atomic absorption and emission spectroscopy, spectrophotometric methods (UV, visible, luminescence, and automation), chromatography, ion-selective electrodes, and microwave digestion. Infrared spectroscopy, atomic ratio and molecular mass spectroscopy, nuclear magnetic resonance will also be included. Provides hands-on experience with modern analytical instruments. Prerequisites or graduate standing required. Pre: (CHEM 2114, CHEM 2124) or (CSES 3114, CSES 3124). (3H,3L,4C)

#### 4764 (ENSC 4764): BIOREMEDIATION

Overview of environmental biotechnology and the use of microbes and other organisms to remove contaminants and improve environmental quality. Topics include treatment of contaminated soils, waters, and wastewaters, as well as remediation of industrial waste streams. Pre: BIOL 2604. (3H,3C)

**4774 (ENSC 4774): RECLAMATION OF DRASTICALLY DISTURBED LANDS**

Remediation, rehabilitation, and revegetation strategies for lands disturbed by mining, construction, industrialization, and mineral waste disposal. Disturbed site characterization and material analysis procedures. Regulatory and environmental monitoring frameworks for mining sites and other disturbed lands. Prediction and remediation of water quality impacts from acid drainage. Pre: 3114 or GEOS 3614 or ENSC 3114 or CSES 3134 or ENSC 3134 or CSES 3304 or GEOG 3304 or GEOS 3304. (3H,3C)

**4854 (ENSC 4854): WETLANDS SOILS AND MITIGATION**

Wetland soils as components of natural landscapes: biogeochemistry, hydrology, geomorphology, hydric soil indicators, and wetlands functions under various land uses. Soil and hydrologic factors important to wetland delineation and jurisdictional determination. Mitigation of wetland impacts with emphasis on restoration and creation. Outdoor lectures at local wetlands and a two-day long field trip to observe and identify wetland soils are mandatory. Pre: (3114, 3124) or (ENSC 3114, ENSC 3124) or (GEOS 3614, GEOS 3624) or CSES 3134 or ENSC 3134. (2H,3L,3C)

**4864: CAPSTONE: CROP & SOIL SCIENCES**

Experiential and discussion-based learning that utilizes prior knowledge gained in the major to synthesize information, and prepare a written comprehensive work plan that is defended orally. Review available careers in the crop and soil sciences. Compose and critique resumes and cover letters. CSS majors only. Pre: Senior standing. (3H,3C)

**4964: FIELD STUDY**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Dairy Science

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### Overview

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**Head:** R. M. Akers

**Named Professors:** R. M. Akers - Horace E. and Elizabeth F. Alphin Professor, M. D. Hanigan - David R. and Margaret Lincicome Professor, and K. F. Knowlton - Colonel Horace E. Alphin Professor of Dairy Science

**Professors:** R. E. James

**Associate Professors:** B. A. Corl, I. K. Kanevsky, and C. S. Petersson-Wolfe

**Assistant Professors:** R. Cockrum, K. M. Daniels, and G. Ferreira

**Lecturer:** D.R. Winston

**Career Advisor:** K.F. Knowlton

**Professor Emeritus:** M. A. Barnes, B. G. Cassell, F. C. Gwazdauskas, J. H. Herbein, G. M. Jones, M. L. McGilliard, R. L. Nebel, R.E. Pearson, C. E. Polan, R. G. Saacke, C. C. Stallings, and J. M. White

Web: [www.dasc.vt.edu](http://www.dasc.vt.edu)

## Overview

The purpose of the dairy science program is to offer students the opportunity to prepare themselves for a wide variety of careers by developing their technical and interpersonal skills. We offer a challenging yet flexible curriculum that can be individualized to meet the educational needs and interests of each student, counseling to assist each student in designing individual programs, and extracurricular activities to enhance development of interpersonal skills.

Students may select from three curricula: Dairy Enterprise Management; Biotechnology/Pre-veterinary; and Dual Emphasis. All options provide students with the opportunity to acquire a broad education in the sciences, social sciences, economics, mathematics, and communications while learning the basic principles of dairy enterprise management.

## Dairy Enterprise Management Option (DEM)

This is the most flexible curriculum, with at least 30 credits of electives. Suited to students with an interest in various fields of dairy production (herd manager, farm manager), allied agri-business industries (feed, genetics, equipment), agricultural communications, public relations, extension, breed fieldperson, and a variety of other positions. Graduates in this option have also gone on to careers in college instruction, elementary school instruction, bank investment management, feed sales, and milk marketing, to name a few.

## Biotechnology/Pre-Vet Option (BTPV)

This option is recommended for students who plan to continue into veterinary college or other graduate or professional schools, or who plan a career in quality control, laboratory work, or research and product development. It provides an excellent base in chemistry, mathematics, physics, biology and biochemistry for advanced study in many areas.

## Dual Emphasis Option (DUAL)

This is the most popular option and is recommended for students who plan to concentrate in more than one academic area as they prepare for future careers. Common minors and double majors that students may earn while completing their Dairy Science degree requirements include Agricultural Economics, Animal and Poultry Sciences, Biology, Crop and Soil Environmental Sciences, Spanish, Communications, Professional Writing, etc.

## Opportunities to Excel

Nearly all Dairy Science students complete a second major or minor in Animal and Poultry Science, Agricultural Economics, Horticulture, Spanish, Business Communications, Food Science and Technology, or any of many other departments. Students are also encouraged to actively participate in extracurricular clubs, judging teams and the dairy management team. Ninety five percent of students complete at least one internship prior to graduation and nearly half complete undergraduate research, an independent study, or serve as a teaching assistant.

Active participation in research projects in lactation, genetics, nutrition, nutrient management, and management provide qualified students valuable research experience with departmental scientists as well as part-time employment opportunities. These opportunities are available to students in all options and enhance their preparation for advanced study and provide a better understanding of the research process.

The dairy science honors program offers outstanding students the opportunity to enrich and broaden their academic programs. Honors students work closely with individual faculty members in choosing honors classes, colloquia, independent study, and research projects. Graduation "in honors" requires successful completion of university honors requirements, a comprehensive oral examination, and an honors thesis.

Graduate programs of study leading to the M.S. and Ph.D. also are offered (see [Graduate Catalog](#)).

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Requirements for a Minor

Requirements include DASC 2474 (2 cr.), DASC 3474 (3 cr.), DASC 4374 (3 cr.), and twelve additional credits in DASC elective.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the specific degree can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (DASC)

### 2474: DAIRY SCIENCE AND INDUSTRY

Sustainable production, processing, and marketing of milk and milk products domestically and globally. Biology of dairy cattle with emphasis on genetics, reproduction, lactation, and nutrition. Management of dairy herds. (3H,3C)

### 2484: DAIRY CATTLE EVALUATION

Critical appraisal of dairy cattle conformation and experience in linear trait scoring, linear trait relationships to profitability, competitive judging; written and oral justification; organization and conduct of shows and contests; showmanship. (6L,2C) II.

### 2964: FIELD STUDY

Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3134 (APSC 3134): ANIMAL AGRICULTURE AND THE ENVIRONMENT

Environmental issue associated with animal agriculture. Nutrient contamination of water resources, odor emission from livestock farms, environmental regulations affecting animal agriculture, and management practices to reduce the impacts of livestock farms on air and water quality. (3H,3C)

#### 3274: APPLIED DAIRY CATTLE NUTRITION

Application of basic principles of nutrition in developing rations for dairy herds. Emphasis is placed on appropriate use of forages, ration formulation techniques, development of profitable rations, and ration delivery. Pre: ALS 3204. (3H,3C)

#### 3474: DAIRY INFORMATION SYSTEMS

Development, function, and use of dairy information systems including computerized performance testing programs for dairy cattle improvement and dairy herd management. Pre: Junior standing. Pre: 2474. (3H,3C)

#### 4174: APPLIED DAIRY CATTLE GENETICS

Application of genetic principles to dairy cattle improvement. Setting goals for genetic improvement, characteristics of traits included in selection, current methods of estimating breeding values, the role of artificial insemination and breed associations in genetic improvement, cattle genetics. Pre: ALS 3104. (3H,3C)

#### 4274: DAIRY RATION FORMULATION

Develop entry level professional animal nutritionist skills; use customer and feed databases, use optimization algorithms to formulate least cost diets and feed mixes, simultaneous consideration of diet cost, animal product return, and environmental constraints; further develop integrative thinking and problem solving skills. Pre: ALS 3204. Co: 3274. (3L,1C)

#### 4304 (APSC 4304): PRINCIPLES & PRACTICES OF BOVINE REPRODUCTION

Principles and techniques in reproductive physiology and herd management related to health, record keeping, estrus detection and synchronization, and ultrasonography. Ovarian function and superovulation, semen handling, artificial insemination and pregnancy detection are also considered. Pre: ALS 2304. (1H,3L,2C)

#### 4374: PHYSIOLOGY OF LACTATION

Anatomy of the mammary gland and physiology of lactation in domestic and laboratory mammals with emphasis on dairy cattle. Mammary gland health and factors affecting lactation. Principles and techniques in dairy herd milking management. Pre: ALS 2304. (2H,3L,3C)

#### 4384: MAMMARY IMMUNOLOGY

This course is designed to provide students with basic knowledge of immunology as related to diseases of the mammary gland. Concepts of mammary gland immunity, disease etiology, immunopathology, diagnosis and therapy will be covered with a focus on ungulate species. Host pathogen interactions, solving problems, writing intensive, literature search. Pre: ALS 2304, ENGL 1106. (3H,3C)

#### 4474: ADVANCED DAIRY MANAGEMENT EVALUATION

Students will learn to critically evaluate all aspects of dairy farm management on working farms. The assessment and recommendations will be developed using information gathered from herd production records and financial statements, visual observations at the farm, and an interview of the farm owner and workers. Data assessed will include milk, growth, health, reproduction, and culling records; cash flow and profit loss statements; nutrition and nutrient management records; and labor management structure. The assessments and reports will further develop integrative thinking, oral communication, and written communication skills. Pre: 3474, ALS 3104, ALS 3204, ALS 3304. Co: 4475. (6H,2C)

#### 4475-4476: DAIRY ENTERPRISE MANAGEMENT

Decision strategies for modern dairy businesses. 4475: Emphasis on relationships of enterprises and techniques for evaluation of business alternatives, efficiency of production, and profit. Use of microcomputer software to support management decisions. 4476: Concentration on herd replacements, personnel, facilities and issues of management associated with rapidly changing national and international markets, environmental regulations, and computer applications. Group projects and hands-on management of university dairy herd. Pre: 2474 for 4475; 4475 or AAEC 3454, DASC 3474 for 4476. 4475: (3H,3C) 4476: (2H,3L,3C)

#### 4964: FIELD STUDY

Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Electrical and Computer Engineering

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[Undergraduate Course Descriptions \(ECE\)](#)

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**Head and Roanoke Electric Steel Professor in Engineering:** Luke Lester

**University Distinguished Professor:** F. C. Lee

**University Distinguished Professor Emeritus:** A. G. Phadke

**Alumni Distinguished Professor Emeritus:** C. W. Bostian

**American Electric Power Professor:** D. Boroyevich

**Bradley Professor Emeritus of Communications:** W. H. Tranter

**Bradley Distinguished Professor Emeritus of Electromagnetics:** G. S. Brown

**Clayton Ayre Professor:** A. Wang

**Joseph R. Loring Professor in ECE:** S. Rahman

**Willis G. Worcester Professor in ECE:** J. H. Reed

**Thomas Phillips Professor Emeritus:** W. L. Stutzman

**Virginia Microelectronics Consortium Professor:** M. Agah

**Steven O. Lane Junior Faculty Fellow:** W. Saad

**James S. Tucker Professor in ECE:** J. S. Lai

**Grant A. Dove Professor:** Yue (Joseph) Wang

**Professor Emeritus:** J. R. Armstrong, I. M. Besieris, W. A. Davis, D. A. deWolf, F. G. Gray, T. Pratt, K. Ramu, S. M. Riad, F. W. Stephenson, J. S. Thorp, and H. F. VanLandingham

**Associate Professor Emeritus:** R. W. Conners, W. R. Cyre, R. L. Moose, and C. E. Nunnally

**Professors:** M. Agah, P. Ampadu, P. M. Athanas, S. M. Bailey, A. A. Beex, R. P. Broadwater, R. M. Buehrer, C. R. Clauer, G.D. Earle, D. S. Ha, Y. T. Hou, M. S. Hsiao, M. T. Jones, G. Q. Lu, T. L. Martin, T. Mayer, S. F. Midkiff, L. M. Mili, K. Ngo, J-M. Park, P. Plassmann, T. C. Poon, S. Raman, B. Ravindran, A. Safaai-Jazi, W. A. Scales, P. Schaumont, D. J. Stilwell, and J. Xuan

**Associate Professors:** A. L. Abbott, W. T. Baumann, R. Burgos, V. A. Centeno, C. Clancy, S. W. Ellingson, L. J. Guido, J. De La Ree Lopez, M. Hudait, D. K. Lindner, A. B. MacKenzie, M. Manteghi, L. Nazhandali, W. G. Odendaal, C. D. Patterson, J. Paul, J. M. Ruohoniemi, K. S. Tam, C. Wang, C. L. Wyatt, Y. Xu, and Y. Yang

**Assistant Professors:** T. Chantem, D. Bhatra, H. Dhillon, R. Gerdes, X. Jia, K.J. Koh, Q.



Li, R. J. Moran, D. Parikh, W. Saad, R. Williams, G. Yu, H. Zeng, W. Zhou, Yizheng Zhu, and Yunhui Zhu

**Professors of Practice:** K. Giles, G. Manzo, and K. R. Schulz

**Advanced Instructors:** J. Thweatt, A. Ball, K. Cooper, D. McPherson, and L. Pendleton

Web: [www.ece.vt.edu](http://www.ece.vt.edu)

## Overview

The Bradley Department of Electrical and Computer Engineering offers bachelor of science degrees in electrical engineering (EE) and computer engineering (CPE). The difference between these two degrees is one of emphasis. Electrical engineering concentrates on physical processes and design in communications, power and energy, systems and controls, electronics, electromagnetics, and digital systems. Computer engineering emphasizes the development of computer hardware and software systems, such as networks, embedded systems, design automation, and machine intelligence. In addition to undergraduate degrees, the department also offers M.S., M.Eng., and Ph.D. programs in both EE and CPE. An accelerated undergraduate/graduate (UG/G) program is available for qualified undergraduates.

Electrical engineers (EEs) and computer engineers (CPEs) create important and exciting technologies, systems and applications that make the world a better place for all of us. EEs and CPEs are inventing new ways to generate, distribute and use electric power that are more efficient, more sustainable and friendlier to the environment. For example, wider use of solar energy relies on improved photovoltaic devices, power electronics for energy conversion, and power grids. Some of our most critical global infrastructures, including the Internet, mobile voice and data networks, and the electric power grid are designed by EEs and CPEs. And, EEs and CPEs design sensors and embedded systems to monitor intelligent buildings and transportation systems. Applying innovative technologies to biology and the healthcare industry, EEs and CPEs create techniques for medical imaging, methods in synthetic biology to better understand disease, micro-electromechanical systems for medical diagnostics, implantable devices for health monitoring and drug delivery, and information systems to improve healthcare delivery. To meet the challenge of cybersecurity, EEs and CPEs design hardware and software for cryptographic algorithms and develop methods to ensure private communications through the Internet and wireless devices. They design new devices and systems for high-performance computing and networking. They build satellites and instruments to improve communications and enhance our knowledge of space and the Earth. And, EEs and CPEs enhance our leisure time by creating new ways to listen to music, watch movies, play games, communicate with friends, and build social networks.

Students in the Bradley Department of Electrical and Computer Engineering learn from faculty who work at the cutting-edge of engineering research and bring the excitement of their discoveries to the classroom. Engineers want to make things that work and EE and CPE students get hands-on opportunities to build systems from the beginning of their studies. In the freshman year, students explore applications of electrical and computer engineering, such as medical imaging and cryptography. In the sophomore year, EE and CPE students use personal, portable equipment and components to build and explore simple digital and analog electronic systems, which become more complex each semester. Laboratories and team projects throughout the curriculum contribute to an enriching hands-on, minds-on learning experience. By their senior year, students have the option of participating in a team-based, industry-sponsored design project that spans two semesters in which they solve real-world engineering problems while learning project management and team-building skills.

Electrical engineering and computer engineering are dynamic and fast changing fields that drive innovation and solutions to global challenges. The ECE faculty has created a program of study that provides each graduate with a firm foundation in mathematics, physics, and engineering principles, and

with broad experience in different areas of EE and CPE. The program enables our graduates to excel in their EE and CPE specialties, while gaining the tools to adapt to the technical changes and career opportunities they will experience in the future. EE and CPE students develop effective communication and teamwork skills and gain knowledge of ethics, all of which are essential to professional success. EE and CPE graduates are prepared to pursue careers in industry and government, advanced graduate work in EE and CPE, and other advanced professional degrees.

ECE seeks to develop tomorrow's engineering and technical leaders and innovators. Students can enhance their undergraduate experience by participating in multidisciplinary team projects, cooperative education and internships, research experiences for undergraduates, study abroad programs, dual degree and minor programs in other fields, and mentoring programs. The Cooperative Education (co-op) and Internship Program is highly recommended, as is participation in professional societies, including the Institute of Electrical and Electronics Engineers (IEEE) and the Association for Computing Machinery (ACM). ECE works with the Ted and Karyn Hume Center for National Security and Technology to develop future leaders for the US government. ECE offers many scholarships for academic excellence, leadership and service, as well as for participation in various special academic programs.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

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## Undergraduate Course Descriptions (ECE)

### 1574: OBJECT-ORIENTED ENGINEERING PROBLEM SOLVING WITH C++

Problem solving techniques for engineering problems, primarily from the fields of electrical and computer engineering; procedural and object-oriented program development, editing, compiling, linking, and debugging using the C++ programming language. Must have C- or better in the prerequisites. Pre: (ENGE 1024 or ENGE 1215), (MATH 1205 or MATH 1205H or MATH 1225). (2H,2L,3C) I,II.

### 2004: ELECTRIC CIRCUIT ANALYSIS

Introduction to the basic laws and techniques for the analysis of electric circuits. Calculation of the response of circuits with resistors, independent sources, controlled sources, and operational amplifiers. The transient analysis of basic circuits with R, L, and C components. An introduction to AC analysis and phasors. Requires a C- or better in ENGE 1104 or 1204. Pre: ENGE 1104 or ENGE 1204 or ENGE 1114 or ENGE 1216. Co: 2074, MATH 2214. (3H,3C)

### 2014: ENGINEERING PROFESSIONALISM IN ECE

Overview of the nature and scope of the electrical and computer engineering profession. Working in a diverse team environment; professional and ethical responsibility; the impact of engineering solutions in a global and societal context; contemporary issues; and life-long learning. Sophomore standing required. Co: 2504, 2004. (2H,2C)

### 2054: APPLIED ELECTRICAL THEORY

For students in the Mechanical Engineering program or by permission of the ECE Department. Fundamentals of electric circuits; circuit laws and network theorems, operational amplifiers, energy storage elements, response of first and second order systems, AC steady state analysis. Construction,

analysis, and characterization of circuits with student-owned Lab-in-a-Box system. Pre: PHYS 2306. Co: MATH 2214. (2H,2L,3C)

#### 2074: ELECTRIC CIRCUIT ANALYSIS LABORATORY

Construction, analysis, and characterization of circuits with student-owned Lab-in-a-Box system. Experiments include: characterization of breadboard backplane wiring; component tolerances; Ohm's law; Kirchoff's laws; series and parallel resistors; voltage and current dividers; delta-wye configurations; mesh-current and node-voltage analysis; superposition and Thevenin equivalents; inverting and non-inverting amplifier circuits; series RC and RL circuits; discharging LEDs and integrator and differentiator circuits. Introductory design experiments include a simple voltmeter and a flashing traffic arrow. Must have a C- or better in ENGE 1104 or 1204. Pre: ENGE 1104 or ENGE 1204. Co: 2004, MATH 2214. (3L,1C)

#### 2164: EXPLORATION OF THE SPACE ENVIRONMENT

This introductory course covers a broad range of scientific, engineering, and societal aspects associated with the exploration and technological exploitation of space. Topics covered include: science of the space environment; space weather hazards and societal impacts; orbital mechanics and rocket propulsion; spacecraft subsystems; applications of space-based technologies. (3H,3C)

#### 2204: ELECTRONICS

Introduction to basic electronic devices including diodes and transistors and their operating principles. Analysis of electronic circuits operating under dc bias and switching conditions. Applications of devices in digital electronic circuits. Pre: 2004. Co: 2274. (3H,3C)

#### 2274: ELECTRONIC NETWORKS LABORATORY I

Principles of operation of electrical and electronic test equipment and applications to measurement of circuit parameters. Transient and steady state response of RLC networks. Applications of laws and theories of circuits. Design, prototyping, and testing of electronic devices and circuits. Pre: 2074. Co: 2204. (3L,1C) I,II,IV.

#### 2500: COMPUTER ORGANIZATION AND ARCHITECTURE

Computer organization and architecture: instruction formats and construction; addressing modes; memory hierarchy (cache, main memory and secondary memory) operation and performance; simple pipelines; basic performance analysis; simple OS functions, particularly as they relate to hardware; virtual memory; computer I/O concepts, including interrupt and DMA mechanisms; intercomputer communication concepts. Must have C- or better in prerequisite 2504. Pre: 2504. (3H,3C)

#### 2504: INTRODUCTION TO COMPUTER ENGINEERING

An introduction to the design and operation of digital computers, including information representation, logic design, integrated circuits, register transfer description, hardware description languages, basic computer organization and assembly-level programming. The relationship between software and hardware is stressed. This course duplicates material in CS2504 and may not be taken for credit towards graduation if CS2504 is also taken. Pre: 1574. (3H,3C)

#### 2524: INTRODUCTION TO UNIX FOR ENGINEERS

Fundamental concepts of operating systems, emphasizing a hands-on introduction to UNIX. User interfaces, UNIX shell commands, the UNIX file system, task management, common system utilities, the UNIX programming environment. Students gain experience with system installation and administration. Duplicates CS 2204. Must have C- or better in prerequisite 2574. Pre: 2574. (2H,2C)

#### 2534: MICROCONTROLLER PROGRAMMING AND INTERFACING

Operation and applications of microcontrollers, including system level organization, analysis of specific processors, and software and hardware interface design. Pre: 2504. (3H,3L,4C)

#### 2574: DATA STRUCTURES AND ALGORITHMS

Introduces fundamental data structures, algorithms, and abstract data types. Main topics include data structures such as arrays, linked lists, stacks, queues, graphs, and trees, and algorithms such as those that are used for list manipulation, graph searches, sorting, searching, and tree traversals.

Implementation of data structures and algorithms in C++. Pre: 1574. (3H,3C)

#### 2704: SIGNALS AND SYSTEMS

Analysis techniques for signals and systems. Signal representation, including Fourier and LaPlace transforms. System definitions and properties, such as linearity, causality, time invariance, and stability. Use of convolution, transfer functions and frequency response to determine system response. Applications to circuit analysis. Hands-on projects to illustrate and integrate the various concepts. Pre: (2004 or 2004H), 2074, (MATH 2214 or MATH 2214H). (3H,3C)

#### 2964: FIELD STUDY

Variable credit course.

#### 2974: INDEPENDENT STUDY

A minimum GPA of 2.0 in all ECE courses is required for enrollment. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3004: AC CIRCUIT ANALYSIS

Application of the basic laws and techniques of circuit analysis to AC circuits. Complex numbers and algebra with an emphasis on phasor representation of circuits. Calculation of the frequency response of circuits with R, L, and C components, independent sources, controlled sources, and operational amplifiers. Analysis of AC steady-state circuits and determination of average power. Magnetically coupled circuits. Laplace and Fourier transforms. Representation of circuits by two-port models. Pre: 2704. Co: 3074. (3H,3C)

#### 3054: ELECTRICAL THEORY

For students in curricula other than ECE. Fundamentals of electric circuits: circuit laws and network theorems, operational amplifiers, energy storage elements, response of first and second order systems. AC steady state analysis. Pre: PHYS 2306. Co: MATH 2214. (3H,3C)

#### 3074: AC CIRCUIT ANALYSIS LABORATORY

Construction, analysis, and characterization of circuits with student-owned Lab-in-a-Box system. Experiments include: sinusoids and phasors including impedance, admittance, and Kirchhoff's laws; sinusoidal steady-state including node and mesh analysis, Thevenin and Norton equivalent, and op amps; ac power analysis including instantaneous and average power, power factor, and complex power; magnetically coupled circuits including mutual inductance, energy in a coupled circuit, and transformers; frequency response including transfer functions, Bode plots, resonance, and passive and active filters; and two-port circuits. A C- or better is required for all prerequisites. Pre: 2074. Co: 3004. (3L,1C)

#### 3105-3106: ELECTROMAGNETIC FIELDS

Maxwell's equations and their application to engineering problems. 3105: transmission lines, electrostatics, magnetostatics. 3106: time-varying fields, Maxwell's Equations, waves, propagation, guided waves, radiation. Pre: PHYS 2306, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H), (ECE 2004 or EC E 2004H) for 3105; 3105 for 3106. (3H,3C)

#### 3204: ANALOG ELECTRONICS

Small signal modeling of transistors. Basic architecture and functionality of linear amplifiers including transistor biasing circuits, current sources, differential amplifier, common emitter amplifier, common source amplifier, emitter follower, and source follower. Operational amplifier operating principles, circuit design, and applications. Frequency response of single stage and multistage amplifiers. Feedback systems and stability analysis of amplifiers. Pre: 2204, 2704. Co: 3274. (3H,3C)

#### 3254: INDUSTRIAL ELECTRONICS

Fundamentals of electronics, including basic device principles. Include digital, operational amplifier, and analog analysis for industrial applications and magnetic circuits. For students in the Mechanical Engineering program or by permission of the ECE Department. Pre: 2054. (3H,3C)

#### 3274: ELECTRONIC CIRCUITS LABORATORY II

Design, build, and test amplifiers and other electronic circuits to meet specifications. Bipolar and field-effect transistors, diodes, integrated circuits such as operational amplifiers, and passive components are used. Gain, bandwidth, input and output impedance, positive and negative feedback, and circuit stability are implemented in the designs. Digital oscilloscopes, ammeters, voltmeters, function generators, and power supplies are used. A grade of C- or better is required in all pre-requisite courses. Pre: 2274, 3074. Co: 3204. (3L,1C)

#### 3304: INTRODUCTION TO POWER SYSTEMS

Basic concepts of AC systems, single-phase and three-phase networks, electric power generation, transformers, transmission lines, electric machinery and the use of power. Pre-requisite 3004 with C- or better. Pre: 3004. (3H,3C)

#### 3354: ELECTRIC POWER ENGINEERING LABORATORY

Laboratory experiments based on principles of electric power engineering. Co: 3304. (3L,1C) II.

#### 3544: DIGITAL DESIGN I

Design techniques for combinational and sequential logic. Design of digital circuits using standard integrated circuit chips and programmable logic devices. Computer simulation will be used to validate designs. Prototypes will be constructed to demonstrate design functionality. Pre: 2504. (3H,3L,4C)

#### 3574: APPLIED SOFTWARE DESIGN

An introduction to applied software design methods for use in the writing of efficient, reusable, and modular C++ programs. Introduces the use of the following: classes, inheritance, and polymorphism; design patterns; high-level programming techniques using libraries, generics, and containers; widgets, models, and views; software frameworks for embedded systems; and advanced techniques ranging from multi-threading to reflective programming. Pre: 2574. (3H,3C)

#### 3614: INTRODUCTION TO COMMUNICATION SYSTEMS

Analysis and design of analog and digital communication systems based on Fourier analysis. Topics include linear systems and filtering, power and energy spectral density, basic analog modulation techniques, quantization of analog signals, line coding, pulse shaping, and transmitter and receiver design concepts. Applications include AM and FM radio, television, digital communications, and frequency-division and time-division multiplexing. Pre: 2704, STAT 4714. (3H,3C)

#### 3704: CONTINUOUS AND DISCRETE SYSTEM THEORY

Continuous- and discrete-time system theory. Block diagrams, feedback, and stability theory. System analysis with Bode diagrams. Discrete-time stability, difference equations, Z-transforms, transfer functions, Fourier transforms, and frequency response. Sampling of continuous systems and an introduction to digital filtering. Hands-on projects to illustrate and integrate the various continuous- and discrete-time concepts and tools. Pre: 2704. (3H,3C)

#### 3964: FIELD STUDY

Variable credit course.

#### 3974: INDEPENDENT STUDY

Variable credit course.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4104: MICROWAVE AND RF ENGINEERING

Passive and active Radio Frequency 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; measurement techniques. Pre: 3106, 3204, 2014. (3H,3L,4C)

#### 4114: ANTENNAS

Antenna fundamentals, analysis and design principles, and a survey of antenna types including: arrays, wire antennas, broadband antennas, and aperture antennas. Pre: 3106, 2014. (3H,3C) II.

#### 4124: RADIO WAVE PROPAGATION

Behavior of radiated electromagnetic waves in terrestrial, atmosphere, space, and urban environments; path, frequency and antenna selection for practical communication systems; propagation prediction. Pre: 3106. (3H,3C)

#### 4134: FIBER OPTICS APPLICATIONS

Theory of optical fiber waveguide propagation and design applications in communication and sensing systems. I Pre: 3106. (3H,3C)

#### 4144: INTRODUCTION TO OPTICAL INFORMATION PROCESSING

Modern wave optics. The application of Fourier transforms to image analysis, optical spatial filtering, and image processing. Pre: 3106. (3H,3C) II.

#### 4154: INTRODUCTION TO SPACE WEATHER

The space environment from the Sun to the Earth's upper atmosphere and the practical consequences (space weather) of this environment on the modern technologies and human health. Concepts in space plasma physics. Examples of observations and data utilized to illustrate the environment and its dynamic variability. Pre: 3106. (3H,3C)

#### 4164: INTRODUCTION TO GLOBAL POSITIONING SYSTEM (GPS) THEORY AND DESIGN

Fundamental theory and applications of radio navigation with the Global Positioning System GPS. Satellite orbit theory, GPS signal structure and theory, point positioning with pseudoranges and carrier phases, selective availability, dilution of precision, differential GPS, atmospheric effects on GPS signals. Pre: 3106 or AOE 4134, ECE 2014. (3H,3L,4C)

#### 4194: ENGINEERING PRINCIPLES OF REMOTE SENSING

Physical principles involved in remote sensing of Earth's environment and their implementation in engineering systems: fundamentals of electromagnetic wave propagation, scattering by matter, effects of propagation media, passive and active systems, remote sensing platforms, data processing, systems integration, and introductory concepts important for the design and analysis of remote sensing engineering systems. Pre: 3106. (3H,3C)

#### 4205-4206: ELECTRONIC CIRCUIT DESIGN

Stability and response of feedback amplifier, wideband amplifiers, operational amplifier characteristics, waveform generators and wave shaping, nonlinear circuit applications, signal generators, and photolithography. Design of analog electronic circuits, circuit simulation, response characterization, and printed circuit construction. Pre: 3204 for 4205; 4205, 2014 for 4206. (3H,3C) I,II.

#### 4214: SEMICONDUCTOR DEVICE FUNDAMENTALS

Fundamental semiconductor device physics associated with semiconductor materials and devices with an in-depth coverage of p-n and Schottky diodes, bipolar junction transistors and metal-oxide semiconductor and junction field effect transistors. Pre: 2204 or MSE 3204 or PHYS 3455. (3H,3C)

#### 4220: ANALOG INTEGRATED CIRCUIT DESIGN

Integrated circuit design in silicon bipolar, MOS, and BiCMOS technologies for communications, sensor, instrumentation, data conversion, and power management applications. Models for integrated circuit active devices in bipolar and MOS technologies; noise; current mirrors, active loads and references; amplifiers and output stages; operational amplifiers; and an introduction to data conversion circuits. Circuit design at the IC level; modern VLSI CAD software. A grade of C- or better required in pre-requisite 3204. Pre: 3204. (3H,3C)

#### 4224: POWER ELECTRONICS

Power devices and switching circuits including inverters and converters; electronic power processing and control as applied to industrial drives, transportation systems, computers, and spacecraft systems. I Pre: 3204, 2014. (3H,3C)

#### 4234 (MSE 4234): SEMICONDUCTOR PROCESSING

Manufacturing practices used in silicon integrated circuit fabrication and the underlying scientific basis for

these process technologies. Physical models are developed to explain basic fabrication steps, such as substrate growth, thermal oxidation, dopant diffusion, ion implantation, thin film deposition, etching, and lithography. The overall CMOS integrated circuit process flow is described within the context of these physical models. I. Pre: 2204 or 3054. (3H,3C)

#### 4235-4236 (MSE 4235-4236): PRINCIPLES OF ELECTRONIC PACKAGING

This two-course sequence covers principles and analyses for design and manufacture of electronic packages. 4235: 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. 4236: system-level package design issues for meeting application requirements and modeling tools for analyzing electronic packages are introduced. Materials and process selection guidelines are discussed for the manufacturing and reliability of packaged electronic products. Pre: 2204 or 3054 for 4235; 2204, (4235 or MSE 4236) for 4236. Co: 3054 for 4235. (3H,3C)

#### 4244: INTERMEDIATE SEMICONDUCTOR PROCESSING LABORATORY

Design, layout, fabricate, and characterize microelectronic devices. Analyze test results to verify performance to the predetermined specifications. Required oral and written reports. A C- or higher is required in all pre-requisite courses. Pre: (4234 or MSE 4234), ECE 2014. (1H,6L,3C)

#### 4284: POWER ELECTRONICS LABORATORY

Design and testing of electronic power processing systems for commercial and aerospace applications. Co: 4224. (3L,1C) II.

#### 4304: DESIGN IN POWER ENGINEERING

A study of the principles in electric power engineering. Expert systems, superconductivity, DC transmission, motor control, system protection, high performance motors, solar energy, microcomputer applications, machine design, computer-aided design, digital relaying and space station application. I Pre: 3304, 2014. (3H,3C)

#### 4334: POWER SYSTEM ANALYSIS AND CONTROL

Development of methods for power analysis and control. An analysis and design of systems for steady state, transient, and dynamic conditions. Digital solutions emphasized. I Pre: 3304. (3H,3C)

#### 4344: ELECTRIC POWER QUALITY FOR THE DIGITAL ECONOMY

Causes, consequences and solutions of power quality problems that affect the operation of computerized processes and electronic systems. Industry standards, monitoring techniques and economic consideration of power quality issues. Pre: 3304. (3H,3C)

#### 4354: POWER SYSTEM PROTECTION

Protection of power apparatus and systems. Fuses. Voltage and current transducers. Relays. Coordination of relays. Pilot channels. Grounding practices. Surge phenomena. Insulation coordination. Pre: 4334. (3H,3C) II.

#### 4364: ALTERNATE ENERGY SYSTEMS

Electric energy from alternative energy sources including solar, wind, hydro, biomass, geothermal and ocean. Characteristics of direct conversion, electromechanical conversion, and storage devices used in alternative energy systems. Power system issues associated with integration of small scale energy sources into the electricity grid. Pre: STAT 4714. (3H,3C) II.

#### 4374: POWER SYSTEM PROTECTION LABORATORY

Experimental verification of principles and practice of protective relaying. Experiments and design projects to demonstrate the principles and techniques of industrial power system design. Fuses, time overcurrent, and instantaneous relays. Differential relaying for transformers. Distance relaying. Current and voltage transformers. Pre: 4334. Co: 4354. (3L,1C) II.

#### 4405-4406: CONTROL SYSTEMS

4405: Introduction to the design of feedback compensation to improve the transient and steady-state performance of systems. Course covers modeling techniques, root locus analysis and design, Nyquist

criterion, and frequency domain compensation. Pre: 3704 for 4405; 4405 for 4406. (3H,3C)

#### 4424 (CS 4824): MACHINE LEARNING

Algorithms and principles involved in machine learning; focus on perception problems arising in computer vision, natural language processing and robotics; fundamentals of representing uncertainty, learning from data, supervised learning, ensemble methods, unsupervised learning, structured models, learning theory and reinforcement learning; design and analysis of machine perception systems; design and implementation of a technical project applied to real-world datasets (images, text, robotics). A grade of C- or better in prerequisites. Pre: 2574, (STAT 4604 or STAT 4705 or STAT 4714). (3H,3C)

#### 4504 (CS 4504): COMPUTER ORGANIZATION

Overview of the structure, elements and analysis of modern enterprise computers. Performance evaluation of commercial computing. Past and emerging technology trends. Impact of parallelism at multiple levels of computer architecture. Memory and storage. Fundamental computer system descriptions, Amdahl's Law, Flynn's Taxonomy. A grade of C or better required in prerequisites. Pre: 2504 or CS 3214. (3H,3C)

#### 4514: DIGITAL DESIGN II

Advanced digital design techniques for developing complex digital circuits. Emphasis on system-level concepts and high-level design representations while meeting design constraints such as performance, power, and area. Methods presented that are appropriate for use with automated synthesis systems. Commercial hardware description language simulation and synthesis tools used for designing a series of increasingly complex digital systems, and implementing those systems using Field Programmable Gate Arrays (FPGAs). Pre: 3544. (3H,3L,4C)

#### 4520: DIGITAL AND MIXED-SIGNAL SYSTEM TESTING AND TESTABLE DESIGN

Various topics on testing and testable design for digital and mixed-signal systems are studied: fault modeling, logic and fault simulation, fault modeling, automatic test pattern generation, deterministic ATPG, simulation-based ATPG, delay fault testing, design for testability, built-in-self-test and fault diagnosis. Pre: 2574, (3504 or 3544). (3H,3C)

#### 4524: ARTIFICIAL INTELLIGENCE AND ENGINEERING APPLICATIONS

Problem solving methods; problem spaces; search techniques; knowledge representation; programming languages for AI; games; predicate logic; knowledge-based systems; machine learning; planning techniques; reactive systems; artificial neural networks; natural language understanding; computer vision; robotics. Pre: 2574, STAT 4714. (3H,3L,4C)

#### 4525-4526: VIDEO GAME DESIGN AND ENG

4525: Fundamental concepts in the development and engineering of modern 2-D and 3-D real-time interactive computer video games. Game design and engineering principles, game architecture, game mechanics and interaction, computer graphics, strategy, artificial intelligence (AI), optimization, play testing and fuzzy logic are included. 4526: Advanced concepts in the development and engineering of modern 2-D and 3-D real-time interactive computer video systems. Topics include non-player character (NPC) behavior learning, search and planning, player modeling, procedural content generation, AI-assisted game design. Pre: 3574 for 4525; 4525 for 4526. (3H,3C)

#### 4530: HARDWARE-SOFTWARE CODESIGN

An introduction to the design of mixed hardware- software systems, focusing on common underlying modeling concepts, the design of hardware-software interfaces, and the trade-offs between hardware and software components. Students will use simulation tools to conduct experiments with mixed hardware-software systems in the area of embedded systems. Pre: (3504 or 3544), 2534. (3H,3C)

#### 4534: EMBEDDED SYSTEM DESIGN

Introduction to the design of embedded computer systems; design, implementation, and analysis of embedded computer hardware and software; design, implementation, and debugging of complex software applications on embedded systems; and fundamentals of real-time operating systems for embedded computers. Semester-long design project including written and oral presentations. C- or better required in pre-requisites. Pre: 3574, 2534, 2014. (3H,3L,4C)



#### 4540: VLSI CIRCUIT DESIGN

Introduction to the design and layout of Very Large Scale Integrated Circuits (VLSI). Emphasis is placed on digital CMOS circuits. Static and dynamic properties of MOSFET devices, along with integrated circuit fabrication are examined. Computer-aided design tools are used to produce working integrated circuit designs. Pre: 2204, 2504. (3H,3C)

#### 4550: REAL-TIME SYSTEMS

Theory, algorithmic and protocol concepts, mechanisms, and implementations of real-time computer systems. Introduction to real-time systems, real-time scheduling, real-time synchronization, real-time operating system kernels, and real-time resource management algorithms (e.g., scheduling, synchronization), their implementations in production operating system kernels, experimental studies of those implementations, and real-time application development. Pre: 4534 or CS 3214. (3H,3C)

#### 4554: INTRODUCTION TO COMPUTER VISION

Techniques for automated analysis of images and videos. Image formation, detecting features in images, segmenting or grouping image regions and image features, multiple view geometry, object instance and category recognition in images and video processing. Pre: 3574, (STAT 4705 or STAT 4714). (3H,3C)

#### 4560: COMPUTER AND NETWORK SECURITY FUNDAMENTALS

This course introduces fundamental security principles and real-world applications of Internet and computer security. Topics covered in the course include legal and privacy issues, risk analysis, attack and intrusion detection concepts, system log analysis, intrusion detection and packet filtering techniques, computer security models, computer forensics, and distributed denial-of-service (DDoS) attacks. Must have C- or better in ECE 4564 or CS 3214. Pre: 4564 or CS 3214. (3H,3C)

#### 4564: NETWORK APPLICATION DESIGN

Application program interface and network transport services including User Datagram Protocol and Transmission Control Protocol from the Internet Protocol suite. Client-server organization and design of synchronous, asynchronous, and multithreaded client and server applications. Design, implementation, and testing techniques to improve robustness and performance. Partially duplicates CS 4254 and credit will not be allowed for both. Pre: (2504, 2574). (3H,3C)

#### 4570 (CS 4570): WIRELESS NETWORKS AND MOBILE SYSTEMS

Multidisciplinary, project-oriented design course that considers aspects of wireless and mobile systems including wireless networks and link protocols, mobile networking including support for the Internet Protocol suite, mobile middleware, and mobile applications. Students complete multiple experiments and design projects. Pre: 4564. (3H,3C)

#### 4574: LARGE-SCALE SOFTWARE DEVELOPMENT FOR ENGINEERING SYSTEMS

Large-scale software implementations of the hierarchy of engineering analysis, design, and decision evaluation. Computer-aided engineering programs with state-of-the-art computer tools and methods. Operator overloading, dynamic polymorphism, graphical user interfaces, generic programming, dynamic link libraries, and multiple threads. Pre: 3574. (3H,3C)

#### 4580: DIGITAL IMAGE PROCESSING

This course provides an introduction to basic concepts, methodologies and algorithms of digital image processing focusing on the two major problems concerned with digital images: (1) image analysis and object restoration for easier interpretation of images, and (2) image analysis and object recognition. Some advanced image processing techniques (e.g., wavelet and multiresolution processing) will also be studied in this course. The primary goal of this course is to lay a solid foundation for students to study advanced image analysis topics such as computer vision systems, biomedical image analysis, and multimedia processing & retrieval. (3H,3C)

#### 4605-4606: RADIO ENGINEERING

Wireless application circuit design for gain and filter control at radio frequencies to interface the baseband processing systems and the antennas of communication systems. 4605: Design of radio transmitter and receiver circuits using scattering-parameter methods. Circuits include oscillators, radio frequency amplifiers and matching networks, mixers and detectors. 4606: Design of amplitude, frequency, and

pulse-modulated communication systems, including modulators, detectors, and the effects of noise. Design basics and guidelines for phase-locked loops and several power amplifier configurations. Pre: 3105, 3204, 3614, 2014 for 4605; 4605 for 4606. (3H,3C)

#### 4614: TELECOMMUNICATION NETWORKS

An introduction and overview of the architecture, technology, operation, and application of telecommunication networks. Major topics include the convergence of telephone and computer networks, the layered architecture of computer networks with emphasis on the Internet, and wireless network technology and applications. Pre: 2504, 2704, STAT 4714. (3H,3C)

#### 4624: DIGITAL SIGNAL PROCESSING AND FILTER DESIGN

Analysis, design, and realization of digital filters. Discrete Fourier Transform algorithms, digital filter design procedures, coefficient quantization. Pre: C or better in 3704 Pre: 3704, 2014. (3H,3C)

#### 4634: DIGITAL COMMUNICATIONS

System level analysis and design for digital communications systems: analog-to-digital conversion, digital baseband communications, carrier modulation formats, matched filters, bandwidth efficiency, receiver design, link budgets, signal-to-noise ratio, bit error rates in additive- white-noise Gaussian (AWGN) channels, and multiple access. Must have a grade of C- or better in prerequisites 3614 and STAT 4714. Pre: 3614, STAT 4714. (3H,3C)

#### 4644: SATELLITE COMMUNICATIONS

Theory and practice of satellite communications. Orbits and launchers, spacecraft, link budgets, modulation, coding, multiple access techniques, propagation effects, and earth terminals. Pre: 3614. (3H,3C) II.

#### 4664: ANALOG & DIGITAL COMMUNICATIONS LABORATORY

Laboratory experiments which deal with the design and measurement of analog and digital communication systems. Concepts include SNR, Modulation Index, PCM, and spread spectrum. I Pre: 3614. Co: 4634. (3L,1C)

#### 4675-4676: RADIO ENGINEERING LABORATORY

Laboratory techniques for radio frequencies including the design of amplifiers, oscillators, and a single-side-band receiver. Associated measurements will be used. Pre: 3106, 3204 for 4675; 4675 for 4676. Co: 4605 for 4675; 4606 for 4676. (3L,1C) I,II.

#### 4704: PRINCIPLES OF ROBOTICS SYSTEMS

Introduction to the design, analysis, control, and operation of robotic mechanisms. Introduction to the use of homogeneous coordinates for kinematics, dynamics, and camera orientation; sensors and actuators, control, task planning, vision, and intelligence. Pre: (2574, STAT 4714) or (ME 3514, STAT 3704). (3H,3C) II.

#### 4805-4806: SENIOR DESIGN PROJECT

Industry-like experience emphasizing technical project management and professional and ethical development. Students working in teams will complete a substantial hardware, or hardware related software project. Proposal process, design concept, detailed design, implementation and test. Important "real life" engineering professionalism. Two semester long design project. 4805: Electrical Engineering majors must have completed the following courses with a C- or better: ECE 2014, ECE, 3204, and any 3 of the following courses (ECE 3106, ECE 3304, ECE 2534, ECE 3614, ECE 3704). Computer Engineering majors must have completed the following courses with a C- or better: ECE 2014, ECE 2534, ECE 3544 and ECE 3574. 4806: A C- or better in prerequisite Pre: 4805. (3H,3C)

#### 4944: CYBERSECURITY SEMINAR

Theory and practice of cybersecurity problems and solutions for building secure computing hardware, software, and networks. Technical, social and legal aspects of secure systems. Historical and ongoing attacks that spawn real-world responses. Ongoing research in cybersecurity defenses. Senior standing. Pass/Fail only. Pre: 2504 or CS 2505. (1H,1C)

#### 4964: FIELD STUDY

Variable credit course.

**4974: INDEPENDENT STUDY**

A minimum in-major GPA of 2.0 is required for enrollment. Variable credit course. X-grade allowed.

**4984: SPECIAL STUDY**

A minimum in-major GPA of 2.5 is required for enrollment. Variable credit course. X-grade allowed.

**4994: UNDERGRADUATE RESEARCH**

A minimum GPA of 2.0 in all ECE courses is required for enrollment. Variable credit course. X-grade allowed.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Economics

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**Chair:** Sudipta Sarangi

**Professors:** R. Ashley, H. Haller, D. Salehi-Isfahani, S. Sarangi, A. Spanos, and T. N. Tideman

**Associate Professors:** S. Ball and R. Cothren

**Assistant Professors:** E. Bahel, A. Dominiak, S. Ge, A. Smith, K. Tsang, and Z. Yang

**Professor Emeritus:** A. Mandelstamm and A. Kats

**Instructors:** G. Gebremariam and S. Trost

**Undergraduate Advising/Career Advisor:** E. Perdue (231-7726)

Web: [www.econ.vt.edu](http://www.econ.vt.edu)

## Overview

Specialization in economics prepares a person for a wide variety of careers that emphasize the methods and consequences of analytical decision-making in business and government and a broad understanding of the operation of the economy.

Economists are employed in private business and federal, state, and local governments. Economic analysis is directed at a wide range of problems including inflation and recession, environmental problems, taxation decisions, regulatory and antitrust problems, forecasting, and managerial decision-making. Undergraduate work in economics also provides an excellent background for further study in law, political science, urban planning, and business administration.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Degree Options

Science majors can earn a specialization within the major. Specializations include Public Policy, Macroeconomics and Finance, and Business Economics, among others. Requirements for the specialization include choosing from a list of related courses and having a high level of performance in both these courses. Students who complete a specialization will be presented at graduation with a Certificate of Specialization. Letters of reference written by the faculty at the student's request can also reflect this achievement.

### Minor Requirements

The requirements to earn a minor in economics can be found on its checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

### 5-Year B.A. / M.A.

The department offers a 5-year combined bachelor's and master's degree for students with a GPA of at least 3.5. See the undergraduate advisor for details.

### Honors Degree

The department also offers an honors degree. See the undergraduate advisor for details.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.A. and B.S. in Economics can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (ECON)

2005-2006: PRINCIPLES OF ECONOMICS

2005: Microeconomics. Consumer behavior and demand, firm behavior and supply, price determination and market equilibrium under varying industry structure. Applications to labor and financial markets. 2006: Macroeconomics. Measuring aggregate economic activity, macroeconomic problems (such as unemployment and inflation), the monetary system, effects and limitations of monetary and fiscal policies. (3H,3C)

#### 2025H,2026H: HONORS PRINCIPLES OF ECONOMICS

2025H: Microeconomics. Consumer behavior and demand, firm behavior and supply, price determination and market equilibrium under varying industry structure. Applications to labor and financial markets.

2026H: Macroeconomics. Measuring aggregate economic activity, macroeconomic problems (such as unemployment and inflation), the monetary system, effects and limitations of monetary and fiscal policies. (3H,3C)

#### 2894 (PHIL 2894) (PSCI 2894): INTRODUCTION PHILOSOPHY, POLITICS, AND ECONOMICS

Integrated study of philosophy, politics, and economics. Trains students to make decisions that are not only economically sound, but also socially, ethically, and politically informed. Topics included: models of human nature, rational choice theory social cooperation, distributive justice, markets, and democracy.

(3H,3C)

#### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 3004: CONTEMPORARY ECONOMIC ISSUES

The economic analysis of current issues and problems. This course may be repeated with different topic. Pre: 2006 or 2115 or 2125 or 2026H. (3H,3C)

#### 3024: ECONOMIC JUSTICE

This course explores how different assumptions regarding the basis of claims for access to economic resources lead to different outcomes. Students will explore a variety of theories and examine their own beliefs about economic justice. Pre: (2005 or 2025H), (2006 or 2026H). (3H,3C)

#### 3104: MICROECONOMIC THEORY

Theories of demand, production, perfectly and imperfectly competitive price determination, and general market equilibrium. Analytic applications. Pre: Must complete ECON 2005 (with a C or better) and obtain (1) a C- or better in MATH 1205, 1206, and 1114 or (2) a B- or better in MATH 1525 and 1526 or (3) a B- or better in MATH 1015, 1016 and 2015. Pre: 2005, (MATH 1205, MATH 1206, MATH 1114) or (MATH 1015, MATH 1016, MATH 2015) or (MATH 1525, MATH 1526) or (MATH 1225, MATH 1226, MATH 1114) or (MATH 1014, MATH 1025, MATH 1026). (3H,3C)

#### 3114: APPLIED MICROECONOMICS

Application of microeconomic theory in the analysis of policy issues and problems. Topics may include: welfare programs, substance abuse regulation, federalism, technical change, information economics, market regulation. Pre: (3104 or 4104H), (3254 or 4304). (3H,3C)

#### 3204: MACROECONOMIC THEORY

Theories of the determination of the level of aggregate economy-wide activity. Employment, the price level, aggregate national income, and the interest rate. The roles of money and expectations. Pre: (2006 or 2115 or 2125 or 2026H), (3104 or 4104H), (MATH 1206 or MATH 1226 or MATH 1526 or MATH 2015 or MATH 1026). (3H,3C)

#### 3214: MONEY AND BANKING

Money and credit. The U.S. monetary system. Monetary theory, monetary policy and economic stabilization. Pre: (2005 or 2025H), 2006. (3H,3C)

#### 3254: ANALYSIS OF ECONOMIC DATA

Sources of economic data. Application of spreadsheet and/or statistical software to analysis of economic relationships using graphical and regression techniques. Emphasis is on economic applications rather than statistical theory. Pre: (BIT 2405 or MSCI 2405, BIT 2406 or MSCI 2406) or STAT 3005 or STAT 4604 or STAT 4705 or STAT 4714. (3H,3C)

#### 4014: ENVIRONMENTAL ECONOMICS

Economic dimensions and aspects of programs designed to impose quality controls upon the environment. Special emphasis on problems of controlling air and water pollution. Pre: 2005 or 2116 or 2126 or 2025H. (3H,3C)

#### 4044: PUBLIC ECONOMICS

Economic rationale of the public sector. Proper size and functions of government. Market failure, Cost-benefit analysis, public goods provision. Pricing of public enterprise services. Pre: 3104 or 2025H. (3H,3C)

#### 4054: PUBLIC FINANCE

The structure and incidence of taxation in the U.S. Effects of taxes on incentives and economic efficiency. Tax Policy. Pre: 3104 or 2025H. (3H,3C)

#### 4074: LABOR ECONOMICS

Human capital theory, labor supply and demand, discrimination, effects of labor unions and collective bargaining, wage differentials, income distribution. Pre: (2005 or 2116 or 2126 or 2025H), 3254. (3H,3C)

#### 4084: INDUSTRY STRUCTURE

The structure and performance of American industry. Dimensions and measures of market structure. Factors affecting market structure. The relationship between structure and performance. Purpose and effects of antitrust policy, regulation, and other public policies toward industry. Pre: 3104 or 4924. (3H,3C)

#### 4124: GROWTH AND DEVELOPMENT

Theories of economic growth. Policies to foster growth, and their consequences. Pre: 2006, (2025H or 3104). (3H,3C)

#### 4135,4136 (AAEC 4135): INTERNATIONAL ECONOMICS

4135 International Trade: Factor mobility and commercial policy (tariffs, quotas, export licensing). 4136 International Finance: Liquidity, exchange rates, comparative international living standards, foreign aid. Pre: 3104 or 2025H for 4135; 3204 or 4204H for 4136. (3H,3C)

#### 4144: ECONOMICS OF CHINA

Evolution of the Chinese economy since 1949. Exposition of alternative economic systems, the commune, incentive problems, and state owned enterprises. Analysis of recent reforms and their effects on economic efficiency; and key issues of economic transition related to Russia and other East European countries. Pre: (3104 or 2025H). (3H,3C)

#### 4214: ECONOMICS OF HEALTH CARE

Effects of medical care on health; cost and production of medical care; demand for medical care and its financing; structure of the health care industry; reorganization for efficiency. Pre: 2005 or 2025H. (3H,3C)

#### 4304: INTRODUCTION TO ECONOMETRIC METHODS

An introduction to econometric modeling techniques, including regression methods. Particular emphasis on the special problems posed by economic data. Pre: STAT 3005. Co: 3204, 3104. (3H,3C)

#### 4404: ECONOMICS OF ORGANIZATIONS

Economic theories of organization, with specific attention to their internal structure, and to design of incentive systems. Application to mergers, to the relationship between stockholders and managers, etc. Students with one year of economics, calculus and major in some other social science, by permission of the instructor. Pre: 3104 or 4924 or 2025H. (3H,3C)

#### 4424: THE THEORY OF GAMES AND ECONOMIC BEHAVIOR

Introduction to games and solution concepts, such as prisoner's dilemma, noncooperative equilibrium and Nash's bargaining solution. These concepts are applied in analyzing economic problems including bargaining problems, oligopoly and agency. Pre: 3104 or 4104H. (3H,3C)

#### 4434: EXPERIMENTAL ECONOMICS

This is a course in the use of laboratory methods to study behavior in economics and the social sciences. Students will study state-of-the-art methodology in experimental economics, including experimental design, laboratory technique, financial incentives, and analysis of data. Students will participate in, design, and conduct experiments in bargaining, auctions, asset markets, public goods and commons situations, and risky decision-making. Pre: (3104 or 2025H), (BIT 2406 or MSCI 2406 or STAT 2004 or

STAT 3005). (3H,3C)

4454 (NEUR 4454) (PSYC 4454): NEUROECONOMICS

Neural processes related to reward, learning, reflection, delay of gratification, and social interaction. Clinical uses of neuroeconomics research techniques. Implications of neuroeconomics in economics, policy, law and business. Pre: NEUR 2026 or ECON 3104. (3H,3C)

4754: INTERNSHIP

Qualified students are placed in an industry or government position under the combined supervision of a faculty member and a responsible supervisor in the employing agency. Satisfactory evaluation from employer, detailed reports on the internship experience and a specific project will be required of each intern. Pre: Junior standing, QCA of 2.50 or better and consent. Pass/Fail only. Variable credit course. X-grade allowed. Pre: 2005.

4884 (PHIL 4884) (PSCI 4884): ADVANCED TOPICS IN PHILOSOPHY, POLITICS, AND ECONOMICS

Advanced topics at the intersection of philosophy, politics, and economics. Core methods and concepts: utility theory, game theory, social choice theory, public choice theory, markets, justice, and democracy. Senior research project. Pre: Senior standing. Pre: PHIL 2894 or PSCI 2894 or ECON 2894. (3H,3C)

4894: LAW AND ECONOMICS

Analysis of the economic effects of legal rules, with emphasis on the law of property, contract, liability, and land use. Pre: 2005. (3H,3C)

4964: FIELD STUDY

Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## School of Education

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**Professors:** M. D. Alexander, B. S. Billingsley, P. Burge, K. S. Cennamo, E. G. Creamer, P. E. Doolittle, S. L. Ganter, J. W. Garrison, G. E. Glasson, D. Hicks, J. B. Hirt, B. D. Jones, B. B. Lockee, C. A. Mullen, K. Singh, H. D. Sutphin, and J. L. Wilkins

**Associate Professors:** M. A. Barksdale, N. E. Bodenhorn, B. R. Brand, J. M. Brill, P. E. Brott, J. V. Ernst, W. J. Glenn, S. F. Hein, S. M. Janosik, G. F. Lawson, H. A. Mesmer, Y. Miyazaki, K. A. Parkes, W. T. Price, G. E. Skaggs, G. A. Tilley-Lubbs, L. E. Welfare, J. G. Wells, and T. O. Williams

**Assistant Professors:** A. P. Azano, J. M. Bondy, L. B. Farmer, K. M. Patrizio, C. K. Robbins, G. R. Serna, T. T. Stewart, C. L. Ulrich, and J.A. Wilson

**Instructor:** D. Knight

**Clinical Associate Professors:** C. S. Cash, M. D. Kelly, and B. Kreye

**Clinical Assistant Professors:** J. R. Gratto, W. D. Mallory, K. Potter, T. C. Sato, and Y. Wu

**Visiting Assistant Professors:** D. J. Kniola and J. Mukuni

Web: [www.soe.vt.edu](http://www.soe.vt.edu)

## Overview

The School of Education provides professional education programs and degrees only at the graduate level for professionals in Learning Sciences, prospective and experienced teachers, counselors, researchers, and leaders at the elementary, middle, secondary, and post-secondary levels. These programs prepare education professionals for varied employment settings. Special emphasis is placed on science, math, technology, and leadership. Advanced programs are offered at the master's, education specialist, and doctoral levels. To obtain specific information about these programs and their requirements, interested students should consult the Graduate Catalog or visit the School of Education's website ([www.soe.vt.edu](http://www.soe.vt.edu)).

## Entrance to the School of Education

Students enter education programs after completing a bachelor's degree with a major in a content field. Content fields vary depending on the teaching, counseling, or administrative license sought or other educational career goal of the student. There is a link to a listing of the appropriate undergraduate majors for teaching licensure in the Office of Academic Programs section of the School of Education website.

## Licensure and Employment Opportunities

Students completing professional preparation programs are qualified to receive licenses in Virginia, and these licenses are also accepted in most other states. All degree programs are fully accredited by the National Council for Accreditation of Teacher Education and the Virginia Department of Education. Graduates of professional preparation programs are well prepared for their initial responsibilities and are actively recruited by school systems across the state. Advisors counsel students early in their programs with respect to post-graduation placement opportunities.

## Professional Preparation Programs Offered in the School of Education

The School of Education offers graduate professional preparation programs at both the initial and advanced levels. Please consult the Graduate Catalog ([www.graduateschool.vt.edu](http://www.graduateschool.vt.edu)) and the School of Education's website ([www.soe.vt.edu](http://www.soe.vt.edu)) for admission and graduation requirements.

## Undergraduate Course Descriptions (EDCI)

### 2984: SPECIAL STUDY

Repeatable with different course content. Variable credit course.

### 3004: PRE-EDUCATION SEMINAR

Experiential learning in a PreK through 12th grade setting, public or private, exposing students to knowledge, skills, and dispositions of professional educators. Allows for integration of experiential and course-based learning in professional identity formation and exploration of education careers. NOT student teaching. May be repeated for elective credit up to a maximum of 12 credit hours (1 academic credit earned for every 45 hours of field work per 15 week semester, multiples of 3 credits); cannot be used for core or minor requirements. Minimum 10 hours/week available for field work. Junior Standing. Variable Credit Course. Variable credit course. X-grade allowed.

### 3024: ISSUES IN AMERICAN SCHOOLING

Exploration of a range of issues related to education in the United States, including purposes, multicultural implications, reform movements, and the teaching profession. Pre-requisite: Junior Standing required (3H,3C)

### 3144 (HD 3144): EDUCATION OF EXCEPTIONAL LEARNERS

Emphasizes legal, ethical, and economic bases, assessment and eligibility requirements, characteristics and educational implications, and practices pertaining to various exceptionalities. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course.

**4264: INTRO TO READING INSTRUCTION FOR ELEMENTARY STUDENTS: A CLINICAL COURSE**

Overview of reading theory, terminology, and development in grade K-5. Introduction to reading assessment, text selection, lesson planning, and instructional strategies. Supervised clinical setting instructing K-5 learner. Pre: Junior or senior standing. (3H,3C)

**4454 (ME 4454): ENGR. LEADERSHIP/MGMT**

Introduction to management and mentoring skills associated with the application of the engineering design process. Course covers skills necessary for leading diverse teams of people through a technical design project. Managing teams of local high school students through an authentic technical design experience associated with design competitions. Course addresses the practical applications of science, math and engineering, while building and managing teams of people to meet technical project goals. Pre-requisite: ME 4015 or similar team-based design experience, or by permission of instructor. (2H,3L,3C)

**4984: SPECIAL STUDY**

Repeatable with different content. Variable credit course.

## Undergraduate Course Descriptions (EDCT)

**4754: INTERNSHIP IN EDUCATION**

Planned program of clinical practice in education under the direction and supervision of a university supervisor and a selected practitioner. Pre: Recommendation of program area and successful completion of Professional Studies requirement. Variable credit course. X-grade allowed.

**4964: FIELD STUDY/PRACTICUM**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course. X-grade allowed.

## Undergraduate Course Descriptions (EDEP)

**3154 (PSYC 3154): PSYCHOLOGICAL FOUNDATIONS OF EDUCATION**

Emphasizes theories of human learning and the relationship of learning principles to educational practice in general. Within the context of cognitive, social, and behavioral models of learning, attention is given to instructional procedures, student motivation and discipline, and the assessment of educational progress. Junior level standing required. Pre: PSYC 2004 or PSYC 1004. (3H,3C)

**4984: SPECIAL STUDY**

Variable credit course.

## Undergraduate Course Descriptions (EDIT)

**4614: INSTRUCTIONAL TECHNOLOGY: AUDIO-VISUAL AND COMPUTER USES**

An introductory instructional technology course. Principles and production of audio-visual materials and methods in instruction. Application of microcomputers in instruction, emphasizing computer literacy, programming and evaluation of instructional software. Course in methods of teaching, field teaching experience, or teaching experience required. Pass/Fail only. (2H,3L,3C)

**4974: INDEPENDENT STUDY**

Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

## Undergraduate Course Descriptions (EDTE)

2964: FIELD STUDY/PRACTICUM  
Variable credit course.

2984: SPECIAL STUDY  
Variable credit course. X-grade allowed.

4754 (ALS 4754): INTERNSHIP IN EDUCATION  
Planned program of clinical practice in education under the direction and supervision of a university supervisor and a selected practitioner. Recommendation of program area and successful completion of Professional Studies required. Variable credit course. X-grade allowed.

4964: FIELD STUDY/PRACTICUM  
Variable credit course.

4974: INDEPENDENT STUDY  
Variable credit course. X-grade allowed.

4984: SPECIAL STUDY  
Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Engineering Education

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**Head:** D.M. Riley (Interim)

**Assistant Head for Undergraduate Programs:** K.J. Reid

**Assistant Head for Graduate Programs:** H.M. Matusovich

**Professors:** V.K. Lohani, M.C. Paretti, D.M. Riley, and B.A. Watford

**Associate Professors:** J.B. Connor, R.M. Goff, M.H. Gregg, T.W. Knott, H.M. Matusovich, L.D. McNair, and K.J. Reid

**Assistant Professors:** D. Bairaktaroba, J.R. Grohs, D.B. Knight, and W.C. Lee

**Associate Professor of Practice:** W. M. Butler and N.C.T Van Tyne

**Advanced Instructor:** K.J. Hodges and J.L. Lo

**Senior Instructor:** I.L.J. St. Omer

**Associate Professor Emeritus:** T.D.L. Walker

**Academic and Career Advisors:** J.J. Elmore, M.B. McGlothlin Lester, N.L. Smith, and A.N. Ward

Web: [www.enge.vt.edu](http://www.enge.vt.edu)

E-mail: [enge@vt.edu](mailto:enge@vt.edu)

## Overview

The Department of Engineering Education (ENGE) teaches first-year and second-year engineering courses, advises General Engineering (GE) students, and offers a graduate certificate and a Ph.D. in engineering education. The department offers second-year courses in engineering topics such as

computer-aided design and programming.

At the undergraduate level, the department provides the foundation for students to complete a Bachelor of Science degree in one of the College of Engineering programs and move into degree-related employment or graduate studies. At the graduate level, the department prepares students to teach engineering and conduct research related to teaching, learning, and assessment in engineering contexts.

Accreditation statements may be found in the listings for individual undergraduate degree programs.

## Special Facilities

The department includes several research laboratories that focus on generating cutting-edge research in engineering education and translating that research into practice to enhance undergraduate education. Undergraduate students are welcome to join in research projects in these labs and centers.

[www.enge.vt.edu/facilities-labs.html](http://www.enge.vt.edu/facilities-labs.html)

- The Frith Freshman Design Laboratory (Frith Lab) is a space designed to support the retention and development of young engineers through hands-on learning, peer mentoring, and authentic problem-solving. Part collaboration and innovation space, part fabrication and prototyping space, and part learning laboratory, the Frith Lab enables first-year engineering students to learn by dissecting, designing, making, and analyzing engineering products. It features a Tensile/Compression Materials Testing machine, 3-D printers, laser engraver, CNC router, and drill press, along with various hand tools, housed in toolboxes available for checkout.  
[www.enge.vt.edu/facilities-labs/84-frith-lab.html](http://www.enge.vt.edu/facilities-labs/84-frith-lab.html)
- The VT DEEP Lab (Data Enlightened Educational Practice) strives to find ways to bring educational data into the conversation to guide decision-making processes for students, faculty, administrators, and policy makers. Our team takes a systems perspective of higher education whereby we consider a complex set of interrelated variables in investigating educational outcomes. Current projects include developing educational dashboards to illuminate broad patterns in learning data, investigating transfer students pathways into engineering, exploring shared leadership within student design teams using social network analysis, and exploring curricular, co-curricular, and organizational influences on the development of engineering students' learning outcomes. Team members have conducted research in both the U.S. and Australian higher education contexts.  
[www.enge.vt.edu/facilities-labs/147-deep-lab.html](http://www.enge.vt.edu/facilities-labs/147-deep-lab.html)
- The LabVIEW Enabled Watershed Assessment System (LEWAS) integrates hardware and software components to develop learning modules and opportunities for water sustainability education and research. LEWAS brings real-time water data using wireless technology from the Webb branch of Stroubles creek, an on-campus stream, into our first year engineering class for water sustainability education. Integration of LEWAS into upper level engineering courses is in progress.  
[www.lewas.centers.vt.edu](http://www.lewas.centers.vt.edu)
- The Virginia Tech Engineering Communication Center integrates the professional and the technical to create a new kind of engineer. VTECC brings faculty, students, and professionals together to explore, design, practice, and teach communication and collaboration in support of engineering work. Our lab provides a creative think space for engineering students and faculty to break through disciplinary molds and collaborate across boundaries to drive innovation. [www.vtecc.eng.vt.edu](http://www.vtecc.eng.vt.edu)

## First Year Students and General Engineering

The General Engineering (GE) program of the EngE department serves first-year students in the College of Engineering. Through EngE courses, first-year students participate in problem solving and design exercises that represent the essence of the engineering profession. The courses emphasize team-based, design-oriented, hands-on experiences to develop students' concepts of engineering and engineering

methods, while reinforcing the role of concurrent required courses (e.g. mathematics, chemistry, English, physics). They also serve as a foundation for subsequent courses in the various engineering curricula. Coverage of engineering ethics instills a sense of the responsibilities of engineers to society. Algorithm development and computer programming develop logical thinking, provide the background for computer use in later courses, and support problem-solving skills. Spatial visualization skills are developed through engineering graphics, a primary engineering tool. Through writing and presentations, students begin to develop professional communication skills, including audience analysis, visual rhetoric, effective writing styles, opportunities and problems posed by electronic writing environments, issues in collaborative writing, techniques of oral presentation, print and Web-based research, graphics for written and oral presentations, and editing.

All College of Engineering students must own 1) a convertible tablet PC or laptop and a Windows 10 or 8 slate with pen meeting current specifications, and 2) stipulated software used to analyze and solve problems in and out of class. Computer requirements for engineering students can be located at [www.eng.vt.edu/it/requirement](http://www.eng.vt.edu/it/requirement).

## Process for Declaring a Degree-Granting Engineering Major

Entering students are admitted to General Engineering, the first-year program for all engineering curricula. As noted, this program introduces students to foundational concepts and practices in engineering, allows time to adjust to the College, and provides opportunities to investigate the College's individual degree programs and select the branch of engineering or computer science best suited to their skills and interests. At the end of the year - after academic advising, contacts with the various departments, and satisfactory progress - students select a degree program and, if academically eligible, are transferred to the appropriate degree-granting department.

Entry into a degree-granting engineering department requires that students successfully complete all required first-year courses. Students must also earn a minimum grade of C- in any ENGE prefixed courses required before transferring into a degree-granting engineering department.

Please see the College of Engineering catalog section titled "Required Academic Progress" for details, and visit [www.enge.vt.edu/Undergraduate/changing\\_majors/index.html](http://www.enge.vt.edu/Undergraduate/changing_majors/index.html) for application policies and dates.

Change of Major	
<i>Typical First Semester</i>	
CHEM 1035: General Chemistry	(3)
CHEM 1045: General Chemistry Lab	(1)
ENGE 1215: Foundations of Engineering (C-)	(2)
ENGL 1105: Freshman English	(3)
MATH 1225: Calculus of a Single Variable	(4)
<i>Typical Second Semester</i>	
ENGE 1216: Foundations of Engineering (C-)	(2)
ENGL 1106: Freshman English	(3)
MATH 1226: Calculus of a Single Variable	(4)
PHYS 2305: Foundations of Physics I	(4)

## Undergraduate Course Descriptions (ENGE)

1014: ENGINEERING SUCCESS SEMINAR

Introduction to opportunities and resources available to College of Engineering students during their undergraduate career at VT. Practice in information gathering skills critical for engineering students. Practice in oral, written, and visual communication. Preparation of an academic plan. Credit earned for this course may not be used to satisfy degree requirements. Co: 1215. (1H,1C)

#### 1204: DIGITAL FUTURE TRANSITION

Builds on the principles and practice of engineering design introduced in 1024 and introduces various discipline-specific engineering tools. Basic computer organization and Boolean algebra. Signal and information coding and representation. Introduction to networking. For students who have successfully completed 1114 and are now planning to major in Computer Engineering, Computer Science, or Electrical Engineering. Grade of C- or better required of all students attempting entry into College of Engineering programs. Attempts to achieve grade of C- or better limited to two attempts, including attempts utilizing the W grade option. Partially duplicates 1104. Prerequisite requires a grade of C- or better. Pre: 1114. (1H,1C)

#### 1214: ENGINEERING DESIGN TRANSITION

Builds on the principles and practice of engineering design introduced in 1024 and introduces various discipline-specific engineering tools. Topics covered include computer assisted design and analysis and the graphics language. For students who have successfully completed 1104 and are currently planning to major in Aerospace Engineering, Biological Systems Engineering, Chemical Engineering, Civil and Environmental Engineering, Engineering Science and Mechanics, Industrial and Systems Engineering, Materials Science and Engineering, Mechanical Engineering, Mining and Minerals Engineering, and Ocean Engineering. Grade of C- or better required of all students attempting entry into College of Engineering programs. Attempts to achieve grade of C- or better limited to two attempts, including attempts utilizing the W grade option. Partially duplicates 1114. Prerequisite requires grade of C- or better. Pre: 1104. (1H,1C)

#### 1215-1216: FOUNDATIONS OF ENGINEERING

A first-year sequence to introduce general engineering students to the profession, including data collection and analysis, engineering, problem-solving, mathematical modeling, design, contemporary software tools, professional practices and expectations (e.g. communication, teamwork, ethics), and the diversity of fields and majors within engineering. All engineering majors require a grade of C- or better in 1215-16 for transfer into the major. Each course can only be attempted twice, including attempts utilizing the W grade option. 1215: Corequisites MATH 1205 or MATH 1225. Co: MATH 1225 for 1215. (1H,2L,2C)

#### 1354: INTRO TO SPATIAL VISUALIZATION

Introduction to spatial visualization. Training to improve three-dimensional visualization skills. Does not count towards College of Engineering graduation credit. (1H,1C)

#### 1434: FUNDAMENTALS OF ENGINEERING

Introduction to the profession and the College of Engineering. Foundation material in: problem definition, solution and presentation; design, including hands-on realization working in teams; modeling and visual representation of abstract and physical objects; scientific computation; algorithm development, computer implementation and application; documentation; ethics; and professionalism. Various discipline-specific engineering tools. Requires successful completion of a team-based project. Grade of C- or better is required of all students attempting entry into College of Engineering programs. Duplicates 1024, 1104, 1114, 1204, and 1214. This course counts as an attempt at each of those courses. Attempts to achieve grade of C- or better is limited to two attempts, including attempts utilizing the W grade option. Enrollment restricted to external transfer students. Co: MATH 1205. (5H,5C)

#### 1644: GLOBAL ENGINEERING PRACTICE

Develop global competencies, especially communication and leadership, in engineering contexts. Learn about the impact of different political, technological, social, cultural, educational and environmental systems on engineering. Integrates semester-long on-campus module with international module following semester exams ("Rising Sophomore Abroad Program"). On-campus module considers differences across global engineering landscape; strategies and background materials to ensure meaningful and productive time abroad. International module engages students in local culture during visits with



engineering businesses and universities and/or service learning in one of several international regions. Participating in both modules required. Pre: 1215. (5H,3C)

**2314: ENGINEERING PROBLEM SOLVING WITH C++**

Algorithmic problem solving techniques for engineering problems for various fields; flowcharting, pseudocode, object-oriented program development, editing, compiling, and debugging using the C++ programming language. For Engineering students only. Must have a C- or better in ENGE 1104 and/or ENGE 1114. Pre: (1104 or 1114), (MATH 1114 or MATH 2114), (MATH 1206 or MATH 1226). (1H,2L,2C)

**2344: COMPUTER-AIDED DRAFTING**

Introduction to computer-aided drafting concepts, primarily in two dimensions. Creation of two-dimensional system views utilizing lines, polygons, polylines, construction lines; creating drawing views principally applied to facilities design and layout. Must have C- or better in ENGE 1114. Pre: 1114 or 1104 or 1434. (1H,1C)

**2514: INTRODUCTION TO ENGINEERING COMPUTATION AND CONTROL WITH LABVIEW**

Introduces engineering computation and control using the LabVIEW graphical programming language and the text/ matrix-based (and MATLAB compatible) MathScript programming language. Topics include algorithm development, flowcharts, pseudocode, programming control structures, structured programming, object oriented programming (OOP), data-flow programming, data acquisition, analysis and device control. Partially duplicates ENGE 2314. Pre: 1104 or 1114 or 1434. (1H,2L,2C)

**2974: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

I Variable credit course.

**2994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4094 (IDS 4094) (MGT 4094): MANAGING TECH COMMERCIALIZATION**

How technology-based innovations, innovations developed through science or engineering expertise, are leveraged from the innovative idea or concepts to successful commercial products. Examines the frames that guide the technology commercialization process and applies these frames by using cross-functional teams to investigate a commercialization project from opportunity scanning to exploitation. (3H,3C)

**4974: INDEPENDENT STUDY**

Variable credit course. X-grade allowed.

**4984: SPECIAL STUDY**

Variable credit course. X-grade allowed.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course. X-grade allowed.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## English

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**Chair:** Bernice Hausman

**Associate Chair:** Kelly Pender

**Assistant Chair:** Jennifer Mooney

**University Distinguished Professor:** N. Giovanni

**Alumni Distinguished Professors:** T. M. Gardner and L. H. Roy

**Edward S. Diggs Professor in the Humanities:** B. Hausman

**Professors:** J. F. Eska, E. Falco, V. Fowler, P. W. Graham, R. Hicok, N. A. Metz, T. L. Parrish, K. M. Powell, D. H. Radcliffe, and E. Spiller

**Associate Professors:** S. Carter-Tod, G. Chandler-Smith, A. J. Colaianne, J. Dubinsky, C. M. Eska, C. Evia, P. Heilker, S. M. Knapp, J. Mann, E. Meitner, K. Pender, K. Swenson, and J. M. Vollmer

**Assistant Professors:** K. N. Carmichael, K. Cleland, J. Lewis, A. Reed, J. Sano-Franchini, and A. J. Walker

**Senior Instructors:** R. Allnutt, M. Armstrong, M. Bliss, E. Bloomer, R. Canter, Z. K. Combiths, S. Frost, J. Harvill, A. F. Kinder, J. Lawrence, J. Mengert, J. Mooney, S. Mooney, M. D. Moore, A. Murphy, L. Neilan, S. Oakey, H. R. Patton, L. Skinner, M. S. Smith, G. Voros, and J. Wemhoener

**Advanced Instructors:** J. Barton, J. A. Gibbs, E. A. Lautenschlager, V. Ruccolo, and J. Scallorns

**Instructors:** H. Baker, S. Baker, C. Bean, S. Conaway, T. Gardner, V. LeCorre, K. Lewis, S. Martin, and M. Maycock

**Coordinator of Undergraduate Advising:** R. Jacks (231-6212)

Web: [www.english.vt.edu](http://www.english.vt.edu)

## Overview

The Department of English studies the uses of language in a wide variety of texts and contexts, including aesthetic, historical, social, technical, and creative texts. A degree in English will appeal to students who are interested in the study of literature and language and who want to pursue careers in business, government, education, law, speech sciences, writing, publishing, advertising, and social services.

English offers majors in Literature and Language, Professional and Technical Writing, and Creative Writing. It also offers minors in Literature, Language Sciences, Professional and Technical Writing, and Creative Writing.

## English Degree Majors

Students working towards the B.A. in English may choose from three majors, each consisting of 39 required hours.

- A major in Literature and Language  
Within the Literature and Language major, there are three options available to students: (a) The Literature option; (b) The Pre-Education option; and (c) The Pre-Law option.
- A major in Professional and Technical Writing.
- A major in Creative Writing.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

All three of the majors share a common English core, which students generally complete before they begin working on the requirements of the major that they have selected. The core requirements and specific major requirements can be found on their specific individual checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in English.

Satisfactory progress requirements toward the B.A. in English can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Post Graduate Study

Undergraduate majors interested in pursuing advanced degrees (M.A., M.F.A., or Ph.D.) in English

should, with the assistance of their professors and academic advisors, carefully plan their programs of study. It is generally a good idea to take a variety of courses and to fulfill requirements and electives with as many 3000- and 4000-level courses as possible. It is strongly recommended that students planning to undertake post-graduate study acquire a good reading knowledge of a modern and/or a classical foreign language. Getting to know professors and learning as much as possible about the professional elements of the discipline provide excellent preparation for graduate work.

## First-Year Composition

The Curriculum for Liberal Education requires a two-semester freshman sequence to fulfill Area 1 requirements. First-Year Writing (1105-1106), which the Department of English offers as part of its Writing Program, fulfills this Area I Liberal Education requirement. Honors Freshman English (1204H) may substitute for this sequence for students who qualify for placement in Honors English. 1105-1106 and 1204H share a focus on the rhetorical dimensions of writing, speaking, and visual communication, but each is a separate course with distinctive assignments and goals.

**Advanced Standing (AS):** Some students are exempted from ENGL 1105 and granted Advanced Standing on the basis of three scores: SAT Critical Reading, SAT Writing, and Standardized High School Class Rank. Advanced Standing students fulfill their Freshman English requirement with the single advanced course into which they are placed: **ENGL 1106 or Honors ENGL 1204H**. If Advanced Standing students complete the assigned advanced course at Virginia Tech with a C- they receive pass/fail credit for ENGL 1105, the course from which they are exempted. Advanced Standing is a placement category for students at Virginia Tech; it is not related to the Advanced Placement (AP) courses offered in high schools or the AP exam offered by the Educational Testing Service (ETS).

**Credit from AP, CLEP, and IB** exams can fulfill the CLE Area 1 requirement. See "Advanced Placement," "Advanced Standing," and "International Baccalaureate" information in the Admissions section of this catalog.

## Undergraduate Course Descriptions (ENGL)

### 0014: ORAL COMM INTERNATIONAL TAS

For international students taking regular academic loads. Practice in preparing and delivering oral reports in an academic field, as well as advanced pronunciation and aural comprehension exercises for effective classroom communication. Pass/Fail only. X-grade allowed. (3H,1C)

### 1004: INTRO TO ENGLISH STUDIES

First-Year Experience course that prepares students for study and inquiry at a research institution. Introduction to English studies and its various fields: Creative Writing, Professional Writing, and Literature & Language. (2H,2C)

### 1105-1106: FIRST-YEAR WRITING

1105: Introduction to rhetorical analysis, visual rhetoric, critical writing, and critical thinking; intensive reading of works in multiple genres; practice in writing and revision; fundamentals of oral presentations.  
1106: Continued study in rhetorical analysis and the conventions of various genres; intensive instruction in writing and revision of work that incorporates research; experience in oral presentations. (3H,3C)

### 1204H: HONORS FRESHMAN ENGLISH

Introduction to analytical, critical, and interpretive writing and reading at an advanced level and accelerated pace for students whose test scores and high school work indicate readiness for the Honors level of complexity, responsibility, and initiative; in a single semester, reviews the work of 1105 and focuses on the work of 1106 at the Honors level. Placement by the English Department required. (3H,3C)

### 1504: INTRODUCTION TO CONTEMPORARY LINGUISTICS

Introduction to the sounds of language, processes by which words and sentences are formed, how the meanings of words are established by context, and why languages vary and change over time. (3H,3C)

#### 1514: LANGUAGE AND SOCIETY

English language variation considered from social, regional, ethnic, gender, and style perspectives. Emphasis on vernacular varieties of American English. Attention paid to the social evolution of different language varieties. (3H,3C)

#### 1524 (PSYC 1524): LANGUAGE AND THE MIND

Examination of what is unique about human language and the evidence that language affects thought. Investigation of how listeners categorize sounds, parse sentences, and access meaning. Examination of what brain damage and speech errors reveal about language in the brain and mind. (3H,3C)

#### 1604: INTRODUCTION TO POETRY

This course examines the genre of poetry from the Old English period up to contemporary writers. Emphasis is on close reading and poetic forms and conventions. (3H,3C)

#### 1614: INTRODUCTION TO SHORT FICTION

This course introduces the knowledge and skills required to read and understand short stories and novellas. Readings trace the development of short fiction from the fable and myth to contemporary narrative forms. (3H,3C)

#### 1624: INTRODUCTION TO DETECTIVE FICTION

This course introduces students to classic and modern texts of detective fiction from a variety of historical periods and cultural traditions. (3H,3C)

#### 1634: INTRODUCTION TO SHAKESPEARE

This course introduces Shakespeare's drama and poetry, including at least one modern adaptation of a Shakespearean play (play, novel, movie, opera, etc.). Emphasis is placed on how to read a play, how to read Shakespearean verse, and how the various genres of Shakespearean drama differ. (3H,3C)

#### 1644: INTRODUCTION TO WORLD LITERATURE

This course examines masterpieces of world literature in translation. Readings focus upon one or two common themes across places and times. (3H,3C)

#### 1654: INTRODUCTION TO SCIENCE FICTION AND FANTASY

This course introduces a variety of speculative works within the genres of science fiction and fantasy. Attention will be given to the development and principal characteristics of each genre. Emphasis is placed on the social, cultural, and historical contexts in which specific speculative texts have been produced. (3H,3C)

#### 1664: INTRODUCTION TO WOMEN'S LITERATURE

This introductory course examines literary and cultural questions raised by women writers throughout history and from different cultural backgrounds. Emphasis is on women's writing in English, but the course may include some literature in translation. (3H,3C)

#### 1704: HARRY POTTER PHENOMENON

Introduction to a millennial children's literature phenomenon, J.K. Rowling's seven-volume Harry Potter series, and to various critical and cultural responses to the books. Subgenres of fiction used in the series, such as the boarding-school novel and the sports novel; recurring themes in the series; critical concepts such as the Byronic hero and the anti-hero; the role of media in making the series an economic phenomenon; and the relationships of the novels to film versions and fan-fiction spinoffs. (3H,3C)

#### 1EWL: WAITING LIST FOR ENGLISH 1105

(3H,3C)

#### 1HWLH: WAIT LIST HONORS ENGLISH 1204

(3H,3C)

#### 2444 (CLA 2444) (RLCL 2444): ANCIENT GREEK AND ROMAN MYTHOLOGY

Survey of Ancient Greek and Roman mythology and modern interpretations. In English. No knowledge of Ancient Greek or Latin required. Not for credit toward a Latin Minor. (3H,3C)

#### 2534: AMERICAN LITERARY HISTORY

Introduction to American literary traditions, from the Colonial period through Modernism. Emphases on historical, social, and cultural contexts as these are reflected by representative texts. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 2544: BRITISH LITERARY HISTORY

Introduction to British literary traditions, from the Anglo-Saxon period through Modernism. Emphasis on historical, social, and cultural contexts as these are reflected by representative texts. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 2604: INTRODUCTION TO CRITICAL READING

A writing intensive introduction to the techniques and theoretical implications of close reading and to the literary genres of poetry, drama, fiction, and, in some sections, non-fiction. The focus is on four primary texts, at least one of which was written before the eighteenth century and one after it, and on criticism of at least one of these. The course emphasizes the analytical skills, basic critical terminology, and conventions of literary criticism essential to advanced English studies. Intended primarily for English majors and minors. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 2624: READING AND WRITING ACROSS ENGLISH STUDIES

A variable topics, foundational course in the study and practice of reading and writing employed across disciplinary areas in English Studies. Introduction to rhetorical, creative, and professional modes. Writing intensive. Pre: 1106 or 1204H or COMM 2016. (3H,3C)

#### 2744: INTRODUCTION TO CREATIVE WRITING

A workshop for beginning writers who want to explore their talents in poetry, drama, and fiction. Pre: 1106. (3H,3C)

#### 2804 (AINS 2804): CONTEMPORARY NATIVE AMERICAN LITERATURES

This course offers a sampling of fiction, poetry, and non-fiction by the most influential American Indian writers since 1970, authors such as Momaday, Silko, Deloria, Welch, Harjo, and Alexie. Students also learn about those aspects of cosmology and storytelling traditionally shared by all American Indian Nations, as well as about those aspects specific to the individual tribal traditions from which the authors and their characters come. Pre: 1106 or H1204 or COMM 1016. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3024 (RLCL 3024): RELIGION AND LITERATURE

Analysis of literary works and critical debates in such areas as: pilgrimage, myth, disaster, and transcendence. Students will make presentations, develop their own research projects, and design sessions with short reading assignments later in the semester. As a final project, students will assemble a portfolio charting their work in the course. (3H,3C)

#### 3104: INTRODUCTION TO PROFESSIONAL WRITING

This course introduces students to the theory and practice of professional writing and its functions in workplace settings. In this rhetorically-based course, students gain experience with a variety of writing situations, composing documents that solve problems or help readers make decisions. Students learn current conventions and broadly applicable procedures for analyzing the audiences, purposes, and situations of professional writing, and learn strategies for adapting these conventions and procedures to

meet the unique demands of each new situation and task. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3134 (WGS 3134): GENDER AND LINGUISTICS

Exploration of differences--real and imagined--in the speech of men and women. Examination of how language can reflect and reinforce gender inequality. Linguistic phenomena covered: pitch, vocabulary, sound change, language ideologies, and discourse strategies and types. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3144 (RLCL 3144) (SOC 3144): LANGUAGE AND ETHNICITY IN THE UNITED STATES

Exploration of how racial and ethnic identity are expressed through the use of different languages and dialects. Examination of how language is related to issues of equality, social opportunity, and discrimination in the United States. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3154: LITERATURE, MEDICINE, AND CULTURE

The representation of health and illness in literature and the cultural aspects of medicine as a practice. Pre: 1106 or 1204H or COMM 1016. (3C)

#### 3204: MEDIEVAL LITERATURE

This course presents medieval British literature from ca. 700 to 1500 in its representative modes and defining contexts, including the literary influences of pagan antiquity, the native British (Celtic) tradition, Scandinavian and contemporary continental influences, the Crusades, the Byzantine Empire, and the philosophical traditions of neoplatonism and scholasticism. Specific authors and texts will vary, but will include poetry, prose, and drama. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3214: RENAISSANCE LITERATURE

This course presents Renaissance British literature from 1500-1660 in its representative modes and defining contexts, including the discovery of the Copernican universe and the new world, the rise of Protestantism, the resultant Counter-reformation, the movement from humanism to empiricism, and the institution of Parliamentary democracy. Specific authors and texts will vary, but will include poetry, prose, and drama. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3224: LITERATURE OF THE ENLIGHTENMENT

Focus on Restoration and eighteenth-century British literature from 1660 to 1800, the period generally recognized as the Enlightenment. Examination of the new resilience on reason and scientific method rather than superstition and tradition through the study of such writers as Bunyan, Swift, Dryden, and Johnson. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3234: ROMANTIC LITERATURE

This course presents Romantic literature from the late eighteenth century to 1832 in its representative modes and defining contexts, including the French, American, and Industrial Revolutions, the expansion of the British empire, the rise of the novel, Gothicism, and the intellectual influence of periodical essays. Specific authors and texts will vary, but will include poetry, fictional prose, and non-fictional prose. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3244: VICTORIAN LITERATURE

This course presents Victorian British Literature from 1832 to 1901 in its representative modes and defining contexts, including the development of modern science and the decline of traditional religion, the emergence of the mass reading public, and the glorification of the writer's role as prophet, guide, and culture critic. Specific authors and texts will vary, but will include poems, essays, plays, and novels. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3254: AMERICAN LITERATURE BEFORE 1900

This course presents American literature from before 1900 in its representative modes and defining contexts, including colonization, the founding of the republic, the Civil War, the settlement of the west, American Romanticism, and American Realism. Specific authors and texts will vary, but will include poetry and fictional and non-fictional prose. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3264: MODERNIST BRITISH LITERATURE

This course presents Modernist British literature from 1918-1945 in its representative modes and defining

contexts, including World Wars I and II, the collapse of the British empire, the influence of Darwin, Marx, and Freud, and such literary movements as Modernism, Realism, and Stream of Consciousness. Specific authors and texts will vary, but will include poetry, prose, and drama. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3274: MODERNIST AMERICAN LITERATURE

This course presents Modernist American literature from 1918 to 1945 in its representative modes and defining contexts, including World Wars I and II, the Great Depression, and such literary movements as Modernism and Realism. Specific authors and texts will vary, but will include poetry, prose, and drama. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3304 (AINS 3304): THE LANGUAGES OF NATIVE AMERICA

Study of the structures of the native languages of the Americas; their interrelationships; their use in individual speech communities; contact with other languages; the interrelationships of linguistic structure, culture, and thought; their future survival. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3314: WORKING ENGLISH GRAMMAR

This course introduces students to the fundamentals of standard English written grammar. Some attention will also be paid to the use of English grammar for varying purposes. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3315-3316 (TA 3315-3316): PLAYWRITING

A workshop course in the craft and art of playwriting which emphasizes the development of craft and the nurturing of vision and art. 3315: primary focus is on the writing of original scripts with additional attention paid to the work of influential playwrights and critics. 3316: primary focus is on the creative process of developing a play with the collaborative influences of a director, actors, designers, and other theatre professionals. Consent of instructor required for 3316. Pre: 1106 or 1204H or COMM 1016 for 3315; 3315 for 3316. (3H,3C)

#### 3324: ACTS OF INTERPRETATION

Foundational interpretive approaches in literary and rhetorical studies. Emphasis on broad frameworks and their implications for textual analysis. Pre: 2604, 2624. (3H,3C)

#### 3364: TOPICS IN LITERATURE BY WOMEN

This rotating topics course examines literature written by women with different national and ethnic identities and from different historical periods. Specific content varies, but the common focus is on the fundamental issues surrounding women's writing, the critical methodologies commonly employed to analyze this writing, and the historical, social, and literary contexts influencing the particular writing being studied. May be repeated once with different content. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3414 (GER 3414): GERMAN LITERATURE IN ENGLISH

A variable content course devoted to the study of major German literary works in English translation. May be repeated with different content. May not be taken for credit toward a major or minor in a foreign language. No knowledge of German required. In English. One 2000 level English literature course required. (3H,3C)

#### 3424 (RUS 3424): RUSSIAN LITERATURE IN ENGLISH

Variable-content course devoted to the study of Russian literary classics. Readings and lectures in English. Topics will range from general surveys of 19th century or 20th century Russian literature to more intensive study of the works of a single major author like Tolstoy or Dostoevsky. May be repeated with different content. No knowledge of Russian required. In English. One 2000 level English course required. (3H,3C)

#### 3514: ETHNIC LITERATURE FOR CHILDREN

This course examines the historical contexts of and issues surrounding ethnic literature for children. The course considers the literature in terms of aesthetics, cultural representations, and identity. Ethnic literatures considered may include Native American, African American, Asian American, and Latino/a. The course also introduces other ethnic literary traditions, such as world folk tales, that influence or



parallel American ethnic children's books. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3524: LITERATURE FOR CHILDREN

General critical and historical survey of traditional and contemporary writing for children: picture books, folk literature, modern fantasy, poetry, drama, modern fiction, historical fiction. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3534: LITERATURE AND ECOLOGY

Study of the poetry, proses and dramatic literature that stresses human cooperation with nature conceived as a dynamic, interrelated series of cyclic feedback systems. Included are ways esthetic values (literary themes, form, vision, perception, language) intersect with selected ecological concepts such as biocentrism, the food chain, energy transfer, Gaia theory, and ecofeminism; selected works by contemporary ecologists and environmentalists, and a study of the origins of ecology in the Greek oikos or home. This is a writing intensive course. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3544 (CINE 3544): LITERATURE AND CINEMA

Works of literature and the films into which they have been transformed; emphasis on differences between media. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3584: THE BIBLE AS LITERATURE

This course focuses on the Bible both as a work of literature and as a major influence on the literatures of the world. Specific books of the Bible to be covered, as well as literary-critical approaches, will vary. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3614: SOUTHERN LITERATURE

The literature of the American South from 1840 to the present with emphasis on 20th-century fiction, drama, and poetry. Concentration on such writers as Faulkner, Capote, Chopin, Hughes, O'Connor, Welty, Walker, and others. Exploration of such themes as importance of land, family, community; roles of industry and agrarianism; race relations. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3624: APPALACHIAN LITERATURE

Appalachian writers from the 1800s to the present, including Murfree, Wolfe, and selected contemporary authors. Course will treat artistic merit and such selected themes as the mountains, Appalachia as a frontier, ambivalence about the Civil War, religion, folk ways and traditions, coal mining, and cottage industries. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3634 (AFST 3634): AFRICAN-AMERICAN LITERATURE

African-American writings from Phyllis Wheatley through the slave narratives of the nineteenth century to such modern figures as Wright, Hughes, Baldwin, and Morrison. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3644: THE POSTCOLONIAL NOVEL

A study of novels examining the historical, social, and cultural contexts before, during, and after colonization. Emphasis on major writers (e.g., Achebe, Coetzee, Roy, Phillips) across continents (Africa, Asia, North America) and the significant themes, tropes, and theories of the genre. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3654: ETHNIC AMERICAN LITERATURE

Variable content course which introduces major American ethnic literatures: African-American, Asian-American, Chicano/a, Arab-American, and Native American. Representative texts from one or two of these categories are examined within the cultural, historical, and geographical matrices within which they are written. May be repeated twice for credit if the content is different. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3684: LITERATURE AND THE LAW

This course introduces students to the representation of the law and lawyers in literature. Emphasis is placed on the cultural and historical contexts that shape our perception of the law and legal practice and on the use of facts, research, interpretation, and rhetoric in legal argument. Junior standing required. (3H,3C)

#### 3694: TOPICS IN WORLD NOVELS

Rotating-topics course in world novels, either translated into, or originally written in, English. Emphasis on critical reading of novels written from different cultural contexts. May be repeated once with different topics. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3704: CREATIVE WRITING: FICTION

This course is designed for students who want to focus in some depth on the writing of various forms of fiction such as the short story and novella. Emphasis is on the writing and critiquing of original fiction in a workshop/studio environment, and the analysis of exemplary texts which serve as models. Students produce a body of original fiction in draft and revised forms. May be repeated for a maximum of 9 credit hours. Pre: 2744. (3H,3C)

#### 3714: CREATIVE WRITING: POETRY

This course is designed for students who want to focus in some depth on the writing of poetry. Emphasis is on the writing and critiquing of original poetry in a workshop/studio environment, and the analysis of exemplary poems which serve as models. Students analyze various poetic forms and produce a revised body of original poetry. May be repeated for a maximum of 9 credit hours. Pre: 2744. (3H,3C)

#### 3724: CREATIVE WRITING: CREATIVE NON-FICTION

This course is designed for students who want to focus in some depth on the writing of creative non-fiction in its various forms, including memoir, personal experience writing, the lyrical essay, travel narratives, and nature writing. Emphasis is on the writing and critiquing of original creative non-fiction in a workshop/studio environment and the analysis of exemplary texts which serve as models. Students produce a body of original non-fiction in draft and revised forms. May be repeated for a maximum of 9 credit hours. Pre: 2744. (3H,3C)

#### 3734: COMMUNITY WRITING

Introduction to the theory and practice of managing service-learning writing projects in schools, community centers, retirement communities, and public libraries. Survey of best practices in creative writing pedagogy and in creating sustainable community partnerships. Pre: 2744. (3H,3C)

#### 3744: WRITING CENTER THEORY & PRACTICE

Focus on the theory and practice of teaching writing across the disciplines in the Writing Center setting. Emphasis is on writing center theory applied to one-on-one teaching strategies and on techniques for responding appropriately to student writing. To take this course you must first have the professor's consent. (3H,3C)

#### 3744H: WRITING CENTER THEORY AND PRACTICE

Focus on the theory and practice of teaching writing across the disciplines in the Writing Center setting. Emphasis is on writing center theory applied to one-on-one teaching strategies and on techniques for responding appropriately to student writing. To take this course you must first have the professor's consent. (3H,3C)

#### 3754: ADVANCED COMPOSITION

Advanced training in writing analytical and critical essays. Practice in addressing a range of audiences and in using varied styles and organizational patterns. Workshop and conference for students in arts and humanities, as well as for technical and extension students who wish to address non-specialized audiences and to practice forms outside their own fields. Junior standing required. (3H,3C)

#### 3764: TECHNICAL WRITING

Principles and procedure of technical writing; attention to analyzing audience and purpose, organizing information, designing graphic aids, and writing such specialized forms as abstracts, instructions, and proposals. Junior standing required. (3H,3C)

#### 3774: BUSINESS WRITING

Extensive practice in forms of persuasive and informative writing such as memos, case analyses, reports, abstracts, and letters. Designed for students in all curricula. Junior standing required. (3H,3C)

#### 3804: TECHNICAL EDITING AND STYLE

Technical Editing and Style explores the art of editing from the initial writing task to the final delivery of the document. In addition to learning document management, students study and practice the roles, responsibilities, and tasks that editors perform. The course also covers the rules that govern the fundamentals of style (correctness, clarity, and propriety) and the principles needed to match the tone and formality to the aim, audience, and occasion of the work. Must have pre-requisites or the consent of the Director of Professional Writing. Pre: 1106 or 1204 or 1204H or COMM 1016. (3H,3C)

#### 3814: CREATING USER DOCUMENTATION

This course prepares students to produce both print and online user documentation that enables people to accomplish a given set of tasks (e.g., user guides, online help, policy and procedure manuals, tutorials, and how-to books). Readings include rhetorical theory and discussions of professional practice. Students learn the principles of user and task analysis, information design, usability testing, and indexing. In addition, they have opportunities for hands-on experience with clients and end-users. Must have pre-requisites or the consent of the Director of Professional Writing. Pre: 3804. (3H,3C)

#### 3824: DESIGNING DOCUMENTS FOR PRINT

This course prepares students to design and produce complex documents such as proposals, brochures, booklets, and newsletters using computer technologies. Students learn rhetorical and visual factors (e.g., legibility, readability, layout, and integration of text/images) that contribute to the effectiveness and usability of documents. In addition, students study the use of color and electronic image editing. They also master some of the technologies necessary to publish documents from their desktops. In addition to working on individual projects, students engage in collaborative exercises intended to sharpen their teamwork, editing, writing, audience-awareness, and design skills. Must have prerequisite or consent of the Director of Professional Writing. Pre: 3804. (3H,3C)

#### 3834: INTERCULTURAL ISSUES IN PROFESSIONAL WRITING

Focuses on intercultural and international issues in the global workplace. Explores, through examination of theoretical perspectives and practical applications, ways in which notions about culture and national identity shape professional interactions. Provides a foundational understanding of the issues involved in writing and designing documents for international audiences. Pre: 3804. (3H,3C)

#### 3844: WRITING AND DIGITAL MEDIA

Introduction of the fundamental practices and emerging theories of writing with, and for, digital media. Basic authoring in web development syntaxes, critical interpretation of online sources, social media management, and topics of computational abstraction for writers. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4004: LINGUISTIC DISCOURSE ANALYSIS

Introduction to discourse analysis. This course examines spoken and written discourses of English. Further attention will be paid to how discourse functions in political, legal, medical, and educational contexts. (3H,3C)

#### 4034: THE SOUNDS OF LANGUAGE

Examination of the acoustic attributes of vowels and consonants (phonemes), voice qualities, and voice emotions. Establishment of connections between acoustics and articulation. Measurement of interspeaker differences. Study of the linguistic and social reasons for variation within speakers. Basic introduction to digital signal processing tools and auditory phonetics. Pre: 1504 or ISE 3614. (3H,3C)

#### 4054: HISTORY OF THE ENGLISH LANGUAGE

Development of English including both its internal history (sounds, vocabulary, inflections, syntax) and its external history (political, social, and intellectual forces). Indo-European origins through the present, with

special emphasis on the English Language in America. (3H,3C)

#### 4074: ENGLISH SYNTAX

This course introduces the grammatical structures of the English language and the processes by which we create and comprehend English sentences. Emphasis is on recent linguistic models. Topics include morphological structure, form- and structure-class taxonomy, phrase structure, transformational and generative approaches, language variation. Alternative models will be considered. Pre: 1106. (3H,3C)

#### 4084: TOPICS IN LINGUISTICS

An advanced course in such areas of linguistics as phonetics, phonology, morphology, syntax, language change, dialectology, etc. Emphasis will be placed on the analysis of natural language data within contemporary theoretical frameworks. Individual sections will focus upon differing areas of linguistics (to be specified in the subtitle of the course). Repeatable with different content for a maximum of nine credits. Pre: 4064 or 4074. (3H,3C)

#### 4114: CHAUCER

This course examines the life, work, and critical reception of Geoffrey Chaucer. Junior standing required. (3H,3C)

#### 4124: INTRODUCTION TO OLD ENGLISH

Introduction to Old English grammar and reading of Old English poetry and prose. Senior standing required. (3H,3C)

#### 4134 (PSYC 4134): LANGUAGE DEVELOPMENT

Survey of theories, mechanisms, and processes in human language development. Empirical overview of phonology, semantics, syntax, and pragmatics. Developmental trajectories of mono- and multilingual children. Cultural constraints on language. Perception of language and production of language, in typical and atypical subpopulations (e.g., hearing impairment). Junior/Senior Standing. Pre: PSYC 1004 or PSYC 2004. (3H,3C)

#### 4165,4166: SHAKESPEARE

The plays of Shakespeare. 4165: Shakespeare's early career (1590-1600), including history plays from HENRY VI to HENRY V, comedies from THE COMEDY OF ERRORS to THE MERRY WIVES OF WINDSOR, and early tragedies such as ROMEO AND JULIET and JULIUS CAESAR. 4166: the later career, including "problem plays" such as MEASURE FOR MEASURE, the great tragedies (HAMLET, KING LEAR, OTHELLO, MACBETH), and the romances such as THE TEMPEST. (3H,3C)

#### 4214: MILTON

Milton's poetry from the early works, including COMUS, LYCIDAS, and the sonnets, to his major late works PARADISE LOST, PARADISE REGAINED, and SAMSON AGONISTES; with some attention to the important prose and to the historical context in which he wrote. (3H,3C)

#### 4314 (STS 4314): NARRATIVE MEDICINE

Introduction to the field of narrative medicine, with attention to narrative competence, the use of narrative in medical education, and the function of narratives in the experience of healing. Includes narrative approaches to biomedical ethics. Pre: 3154 or 3324. (3H,3C)

#### 4434: THE AMERICAN NOVEL

Development of the American novel from its beginnings in the late 18th century to 20th century postmodernism. Emphasis on works representative of major authors (e.g., Twain and Morrison), important types (e.g., the romantic novel, the historical novel), and significant American themes (e.g., religion, nature, slavery, the frontier). Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 4444: THE BRITISH NOVEL

Development of the British Novel from the mid- eighteenth century to World War II, including works by such novelists as Defoe and Austen (origins through romantic era), Dickens, Hardy, and Stevenson (Victorian and Edwardian era), Joyce, Woolf, and Waugh (modern period). Emphasis on evolution of generic styles and conventions against a changing landscape of historical and cultural change. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 4504: MODERN POETRY

British and American poetry from 1900 to World War II with emphasis on such figures as Pound, Williams, Stevens, Yeats, Plath, Smith, and Eliot. (3H,3C)

#### 4514: CONTEMPORARY POETRY

British and American poetry from World War II to the present, with emphasis on such figures as Bishop, Lowell, Ashbery, Heaney, and Hughes. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 4624: STUDIES IN A BRITISH AUTHOR AFTER 1800

This course examines the life, work, and critical reception of a single major British author (or pair of closely associated authors) writing after 1800. May be taken up to 3 times with different content. Junior standing required. (3H,3C)

#### 4634: STUDIES IN AN AMERICAN AUTHOR BEFORE 1900

This course examines the life, work, and critical reception of a single major American author (or a pair of closely associated authors) writing before 1900. May be taken up to three times with different content. Junior standing is required. (3H,3C)

#### 4644: STUDIES IN AN AMERICAN AUTHOR AFTER 1900

This course examines the life, work, and critical reception of a single major American author (or pair of closely associated authors) writing after 1900. May be taken up to three times with different content. Junior standing is required. (3H,3C)

#### 4664: CONTEMPORARY FICTION

Fiction since 1945 with emphasis upon the most recent two decades: the late modernist narratives of Bellow, Updike, and Percy; the new fiction of Barth, Hawkes, Barthelme; the postmodern fiction of Federman, Carter, Fowles, Katz, Sukenick. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 4674: STUDIES IN CONTEMPORARY CULTURE

Studies the emerging changes across arts media (including architecture, cyberculture, essay, fiction, film, painting, performance, photography, poetry, theatre, video) in relation to current cultural and social theory from a variety of disciplines (including architectural theory, art, history, literature, philosophy, psychoanalysis, and social sciences). (3H,3C)

#### 4684: SPECIAL TOPICS IN LITERATURE

An advanced, variable-content course which explores a significant or emergent literary issue or approach, or a body of literature. May be taken twice with different content. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 4704: ADVANCED CREATIVE WRITING: FICTION

Designed for senior English majors who have selected the Creative Writing option, this is an intensive, advanced workshop. This capstone course builds on skills students have acquired in creative writing workshops. Primary focus is on the writing and critiquing of original fiction, while paying close attention to the work of established writers who are acknowledged masters of their genres. Students hone their skills as peer reviewers and constructive critics. In the process, they produce a portfolio of their own fiction. Pre: 3704. (3H,3C)

#### 4714: ADVANCED CREATIVE WRITING: POETRY

Designed for senior English majors who have selected the Creative Writing option, this is an intensive, advanced workshop. This capstone course builds on the skills acquired in previous creative writing workshops. 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. Students hone their skills as peer reviewers and constructive critics. In the process, they produce a portfolio of their own poetry. Pre: 3714. (3H,3C)

#### 4724: CREATIVE WRITING: FICTION FOR YOUNG PEOPLE

This course is conducted in a workshop setting in which students compose original stories for young people. Elementary techniques of fiction are emphasized, such as plot structure, point of view, setting,

characterization, and audience. Must have prerequisites or permission of the instructor. Pre: 3704. (3H,3C)

#### 4784: SENIOR SEMINAR

Designed for senior English majors, this is a variable topics, in-depth study of a particular issue or theme in language or literature. This capstone course aims to integrate and synthesize previous work in the discipline, focusing especially on close reading, research, and writing skills. Pre: 1106. (3H,3C)

#### 4804: GRANT PROPOSALS AND REPORTS

This course prepares students to write effective proposals, reports, and informational articles. Students learn to define and write problem statements, program objectives, plans of action, evaluation plans, budget presentations, and summaries. In addition, they sharpen their teamwork, editing, writing, audience awareness, and design skills as they engage in collaborative projects with campus and/or non-profit organizations in the community. Prerequisite or consent of the instructor is required. Pre: 3804. (3H,3C)

#### 4814: DEVELOPING ONLINE CONTENT

Covers the process of creating documents for online environments. Builds on knowledge and skills acquired in foundational Professional Writing courses. Involves production of websites from scratch, starting with low-fidelity mockups and advancing to formatting layouts adaptable to the diverse screen sizes of computers and mobile devices. Focuses on a balance of structure (code), content (information), and format (presentation and design). Pre: 3804, 3844. (3H,3C)

#### 4824: SCIENCE WRITING

Writing in and about the natural and social sciences. Students will write documents such as abstracts, research proposals, and ethnographies, analyze the development of disciplinary writing practices, and study non-fiction science writing for general audiences. Senior standing or instructor approval required. Pre: 1106 or 1204H or COMM 1016. (3H,3C)

#### 4854: WRITING, RESEARCH, STUDY ABROAD

Application of academic abroad experience to student's disciplinary studies on campus. Conducted after international education abroad experience. Collaborative writing and research projects as well as individual, independent research. Approval of course instructor required. Open to all majors. Pre-requisite: A formal study abroad educational experience; department approval. (3H,3C)

#### 4874: ISSUES IN PROFESSIONAL AND PUBLIC DISCOURSE

In this course designed for English majors in the Professional Writing Option, students will focus on the ways in which scientific, technical, and professional communication influence, and are influenced by, public discourse. Drawing on strategies of rhetorical criticism, students will gain an understanding of the persuasive value of style, arrangement, and delivery by investigating their professional roles in helping to structure public debate. Pre: 3804. (3H,3C)

#### 4954: STUDY ABROAD: ISSUES AND TEXTS

An advanced, variable-content and multi-disciplinary course that explores global themes and literature(s) during a month-long, faculty-led summer study abroad experience. Pre-requisite: Junior Standing required. Variable credit course, repeatable up to 6 credits. Variable credit course.

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Undergraduate Non Degree Engineering Courses

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[Overview](#)

[Undergraduate Course Descriptions \(ENGR\)](#)

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### Overview

The following courses are applicable to study in several departments and do not carry departmental designations. Several of the undergraduate courses listed below were developed specifically for students in both engineering and non-engineering majors with the objective of broadening the base of knowledge in cross-disciplinary areas with some background within a technology driven focus. Others were created as part of the academic, professional and personal support services provided for engineering students. Most students will use these courses to satisfy free electives in their programs. Engineering students also may find these courses of value in broadening their perspectives regarding their fields of study and may wish to use them as free electives in their programs.

### Undergraduate Course Descriptions (ENGR)

#### 1014: ENGINEERING RESEARCH SEMINAR

Discussion of current research topics in the College of Engineering by Virginia Tech Faculty. Credit earned for this course may not be used to satisfy degree requirements. Pass/Fail only. (1H,1C)

#### 1034: FIRST YEAR HYPATIA SEMINAR

Success strategies that are designed for first-year female engineering students who are residents of the Hypatia learning community are presented. Students are provided information on study skills; resources and academic support for Virginia Tech students; gender issues in engineering; service learning; leadership; technology; and the College of Engineering's departments/majors. Credit not applicable to meeting degree requirements. (2H,2C)

#### 1054: FIRST YEAR GALILEO SEMINAR

Success strategies that are designed for first-year male engineering students who are residents of the Galileo learning community are presented. Students are provided information on study skills; resources and academic support for Virginia Tech students; gender issues in engineering; service learning; leadership; technology; and the College of Engineering's department/majors. Credit not applicable to meeting degree requirements. (2H,2C)



#### 1814: ENERGY, RESOURCE DEVELOPMENT AND THE ENVIRONMENT

Population trends. Renewable and non-renewable energy. Coal mining methods, reclamation of mined lands. Petroleum and natural gas. Nuclear waste. Land management, aquifer depletion. Development of mineral reserves, surface and underground mining, environmental impacts. Minerals in world economics. Geopolitical concerns. Global environmental effects of industrial enterprises. Sustainable development. Effects of social structures. Regulatory processes and national/international legislation. (3H,3C)

#### 2004A: ENGINEERING INTERNATIONAL ACTIVITY

Engineering International Education course reflects academic effort in study abroad settings as defined by the college. No degree applicable credit awarded. Enrollment in this course does not apply toward the definition of full time status. 0 Credits. (0C)

#### 2004E: ENGINEERING EXPERIENTIAL LEARNING

Engineering Experiential course reflects college defined experiential learning experiences for undergraduates. No degree applicable credit is awarded. Enrollment in this course does not apply toward the definition of full time status. (0C)

#### 2004R: ENGINEERING UNDERGRADUATE EXPLORATORY ACTIVITY

Engineering Undergraduate Exploratory Activity course is an undergraduate research experience as defined by the college. No degree applicable credit is awarded. Enrollment in this course will not apply toward the definition of full time status. 0 Credits. (0C)

#### 2004S: ENGINEERING SERVICE LEARNING

Engineering Service Learning course reflects academic effort in service learning settings as defined by the college. No degree applicable credit is awarded. Enrollment in this course will not apply toward the definition of full time status. 0 Credits. (0C)

#### 2044: SECOND YEAR HYPATIA SEMINAR

Success strategies designed for second year women engineering students who are participants of Hypatia, the women in engineering residential community; topics include women in the engineering workplace, leadership, and goals associated with academic and professional success. Credit not applicable to meeting degree requirements. (1H,1C)

#### 2054: GLOBAL ENGINEERING PRACTICE

Global teaming, leadership in engineering, achievement of cultural competency for engineers, cultural, social, and economic aspects of practicing engineering abroad, international awareness, immersive international experience, historical aspects of technology, art and design. For rising sophomore students in the college of engineering. Pre-requisite may be waived with permission of instructor. Pre: ENGE 1024. (3H,3C)

#### 2064: GALILEO SEMINAR FOR SOPHOMORES

This course is designed to assist sophomore students who are participants of Galileo, an engineering learning community in their efforts to become/remain successful students at Virginia Tech. The course will include focus on issues regarding the workplace, leadership, and goals associated with academic and professional success. Credit not applicable to meeting degree requirements. Pre: 1054. (1H,1C)

#### 2164 (COS 2164): INTRODUCTION TO SCIENCEERING

Seminar-based course providing a survey of current interdisciplinary science and engineering research problems; introduction interdisciplinary thinking and communication; issues related to interdisciplinary research teams. (1H,1C)

#### 2464: ENGINEERING FUNDAMENTALS FOR SCIENTISTS

Introduction to the engineering profession and basic engineering skills for students pursuing science majors. Fundamentals of graphing, technical communication, ethics, the design process, project management, and problem solving as applicable to engineering. Partially duplicates ENGE 1024. May not be used for credit towards any degree from the College of Engineering. Pre: 2164 or COS 2164. (2H,2C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

2994: UNDERGRADUATE RESEARCH

Variable credit course.

3004: MENTORING SEMINAR

Course will prepare engineering students to mentor first year engineering students: focus on leadership and team building skills, study skills development, technology skills engineering departments/majors, college policies and procedures. Credit not applicable to meeting degree requirements. Pass/Fail only. (1H,1C)

3124: INTRODUCTION TO GREEN ENGINEERING

Introduction to green engineering and global environmental issues. Impacts of human and engineering activities on the environment, and techniques that can be utilized to minimize adverse environmental impacts with emphasis on environmentally conscious design and manufacturing. Pre: (CHEM 1035 or CHEM 1074), (ENGE 1216 or ENGE 1104 or ENGE 1114), PHYS 2306. (3H,3C)

3984: SPECIAL STUDY

Variable credit course.

4064 (COS 4064): SCIENEERING CAPSTONE

A capstone experience centered around an open-ended, faculty-advised senior project involving the design of a process, material, or technique for solving an interdisciplinary problem. Pre: Enrollment in Interdisciplinary Engineering and Science Minor. Pre: 2464 or BIOL 2124. (3H,3C)

4134: ENVIRONMENTAL LIFE CYCLE ASSESSMENT

Quantification of the environmental impacts for products, processes, and systems across all engineering disciplines. A detailed look at life cycle phases and formal and informal Life Cycle Assessment (LCA) methodologies including ISO standards, stream-lined LCA, green building ratings systems, carbon footprints, and other environmental ratings systems. Pre: 3124. (3H,3C)

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Honors Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

### Environmental Science

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[Undergraduate Course Descriptions \(ENSC\)](#)

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**Head:** Thomas L. Thompson

**Coordinating Counselor and Career Advisor:** M. J. Eick (231-8943; [eick@vt.edu](mailto:eick@vt.edu))

**Web:** [www.cses.vt.edu/undergraduate-programs/ensc/index.html](http://www.cses.vt.edu/undergraduate-programs/ensc/index.html)

### Overview

This program brings the basic sciences to bear on many crucial concerns about the environment. The environments of particular interest are terrestrial and wetland ecosystems and associated land and water resources. Specific concerns include environmental protection, pollution prevention and remediation, land-use planning, waste management, ground- and surface-water quality, reclamation and remediation of disturbed or contaminated sites, and minimizing human impacts on the environment.

The Environmental Science curriculum is multidisciplinary and strongly science and technology oriented. The basic sciences and computational skills are at the core of each of the major's three options, but specific requirements make each option unique. The curriculum prepares graduates for immediate entry into environmental careers as well as for graduate specializations. The U.S. Bureau of Labor Statistics

forecasts that employment of environmental scientists and specialists is expected to increase by 28% between 2008 and 2018, much faster than the average for all occupations.

## Water Resources Option

The emphasis in this option is on fresh water systems and resources, although there are obvious connections to estuarine and marine settings. Both surface- and ground-water quality may become degraded as a result of human activities. Those processes, their consequences, and solutions are the focus of this option. Students in this option are entering careers in the areas of regulation, remediation, and environmental protection.

## Land Resources Option

This option develops an understanding of many of the complex biological, chemical, economic, geological, and soil factors that affect land use decision-making. Because our strategy of handling waste is often to "dump it in a hole", this curriculum also deals with issues of waste management and environmental clean-up. The graduates in this option find employment with various governmental agencies and in the private sector.

## Plant Resources Option

This option provides a track for students seeking environmental careers that build on their interest in plant sciences. Plants are used in a variety of ways to solve environmental problems. For example, reclamation of disturbed areas often involves establishing and managing adapted vegetation. Plants are important components of wetlands, which provide a number of important environmental functions and values. Plants are also used to remove pollutants from the soil or water.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Requirements for a Minor

The Environmental Science program also offers a minor. The requirements include CSES/ENSC 3114 plus 3124 (or CSES/ENSC 3134) and CSES/ENSC 3604 and 14 to 15 more hours selected from a set of 23 courses. See [www.cses.vt.edu/undergraduate-programs/ensc/index.html](http://www.cses.vt.edu/undergraduate-programs/ensc/index.html) or visit 240 Smyth Hall for more information about a minor in environmental science.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the specific degree can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Opportunities to Excel

Students with outstanding records can qualify for the Honors Program and graduate "in honors" in environmental science. Other opportunities for personal and professional growth and for recognition include the department-sponsored Environmental Student Organization, membership in Alpha Zeta and other honoraries, and several scholarships designated for majors. Faculty members often offer undergraduates opportunities to become involved in a variety of environmental research projects. Many employers seek environmental science majors for internship and co-op positions.

## Undergraduate Course Descriptions (ENSC)

### 1015-1016: FOUNDATIONS OF ENVIRONMENTAL SCIENCE

Interrelationships between human activities and the environment; emphasis on biological, chemical, and physical principles that govern the flow of energy, materials, and information among physical, ecological and human systems. (3H,3C)

### 2964: FIELD STUDY

Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3114 (CSES 3114) (GEOS 3614): SOILS

Characterization of soils as a natural resource emphasizing their physical, chemical, mineralogical, and biological properties in relation to nutrient availability, fertilization, plant growth, land-use management, waste application, soil and water quality, and food production. For CSES, ENSC, and related plant- and earth-science majors. Partially duplicates 3134. Junior standing. Pre: CHEM 1036. Co: 3124. (3H,3C) I.

### 3124 (CSES 3124) (GEOS 3624): SOILS LABORATORY

Parent materials, morphology, physical, chemical, and biological properties of soils and related soil management and land use practices will be studied in field and lab. Partially duplicates 3134. Co: 3114. (3L,1C)

### 3134 (CSES 3134): SOILS IN THE LANDSCAPE

A study of soils as functional landscape components, emphasizing their physical, chemical, mineralogical, and biological properties in relation to plant growth, nutrient availability, land-use management, and soil and water quality. Primarily for FOR/FIW, LAR, and other plant/earth science related majors. May not be taken by CSES or ENSC majors. Partially duplicates 3114 and 3124. Pre: one year of introductory CHEM or BIOL or GEOS. (2H,3L,3C) II.

### 3604: FUNDAMENTALS OF ENVIRONMENTAL SCIENCE

Interrelationships between human activities and the environment; provides national and global perspective; emphasis is on the physical, chemical, and biological principles and processes that are essential to an understanding of human-environment interactions; the role of energy in human and natural systems; environmental legislation and human behavior. I Pre: BIOL 1105 or CHEM 1035. (3H,3C)

### 3614 (CSES 3614): SOIL PHYSICAL AND HYDROLOGICAL PROPERTIES

Soil physical and mechanical properties and the physical processes controlling soil water retention and flow in agronomic and natural settings. Grain size distribution, weight-volume relationships, specific surface, electrical charge density, consistency, stress, compaction, rainfall runoff, water retention,

steady/non-steady water flow in saturated/unsaturated soil, infiltration, bare soil evaporation, and soil water balance. Pre: (CSES 3114, CSES 3124) or (GEOS 3614, GEOS 3624). (3H,3C)

#### 3634 (CSES 3634): PHYSICS OF POLLUTION

Physical processes that control the fate of pollutants in our land, air, and water resources. Types and sources of pollutants, physical processes in the soil-water-atmosphere continuum controlling the dispersion and deposition of pollutants, the movement of pollutants, including radionuclides, by surface and subsurface water flow in soils, and physics of disturbed soils. I Pre: CSES 3114, PHYS 2206, (MATH 2016 or MATH 2024). (3H,3C)

#### 3644 (CSES 3644): PLANT MATERIALS FOR ENVIRONMENTAL RESTORATION

Overview of ecological principles related to revegetation and restoration of disturbed sites. Function and species requirements of plants in stabilizing disturbed areas including mines, rights-of-way, constructed wetlands, and for the remediation of contaminated soils. I Pre: BIOL 1106. Co: CSES 3114. (3H,3C)

#### 4134 (CSES 4134): SOIL GENESIS AND CLASSIFICATION

Formation of soils across landscape, soil-forming factors and processes, applied soil geology/geomorphology, applied soil biochemistry, soil hydrology, diagnostic horizons and characteristics used in Soil Taxonomy; soil classification and mapping. Three outdoor lectures and one 3-day field trip are mandatory. Pre: (CSES 3114, CSES 3124) or (ENSC 3114, ENSC 3124) or (GEOS 3614, GEOS 3624) or CS ES 3134 or ENSC 3134. (3H,3C)

#### 4164 (BIOL 4164) (CSES 4164): ENVIRONMENTAL MICROBIOLOGY

Ecology, physiology, and diversity of soil and aquatic microorganisms; incorporates the significance of these topics within the context of environmental applications such as bioremediation, wastewater treatment, control of plant- pathogens in agriculture, and pollution abatement in natural systems. The laboratory portion of the course will stress methodology development, isolation and characterization of microorganisms from natural and engineered systems, and examination of the roles of microorganisms in biogeochemical cycling. Pre: BIOL 2604. (2H,3L,3C)

#### 4314 (CSES 4314): WATER QUALITY

Provide comprehensive information on the physical, chemical, biological, and anthropogenic factors affecting water quality, fate and transport of contaminants in water, water quality assessment and management, and current water quality policies. (3H,3C)

#### 4324 (CSES 4324): WATER QUALITY LABORATORY

Teach students a variety of laboratory chemical and biological techniques for water quality analysis. Complementary to ENSC/CSES 4314. Pre: CHEM 1046. Co: CSES 4314, 4314. (3L,1C)

#### 4414: MONITORING AND ANALYSIS OF THE ENVIRONMENT

Provides comprehensive hands-on-laboratory-and field-based experience and information on the principles and methods for field monitoring and sampling, as well the physical, chemical, and biological analysis of soil, surface water, groundwater, and solid wastes within the context of regulatory compliance. Optional 40-hour Hazards Materials (HAZMAT) training will be available. Senior standing required. Pre: (3604 or 4314 or CSES 4314 or BIOL 4004), (MATH 1026 or MATH 2015, CHEM 1036, BIOL 1105). (1H,3L,2C)

#### 4444 (CSES 4444): MANAGED ECOSYSTEMS, ECOSYSTEM SERVICES, AND SUSTAINABILITY

Description and interactions of climate, soils, and organisms within intensively managed ecosystems used to produce food, fiber, bioenergy, fresh water, recreation, cultural, and other ecosystems services essential for human well-being. Ecological concepts applied to agricultural, grassland, and urban/turf ecosystems. Ecologically-based principles for sustainably managed ecosystems. Regional and global significance of managed ecosystems in context of sustainable food systems, and the Millennium Ecosystem Assessment. Pre-Requisite: Junior or Senior Standing required. Pre: CSES 3114 or CSES 3134. (3H,3C)

#### 4734 (CHEM 4734) (CSES 4734): ENVIRONMENTAL SOIL CHEMISTRY

Chemistry of inorganic and organic soil components with emphasis on environmental significance of soil

solution-solid phase equilibria, sorption phenomena, ion exchange processes, reaction kinetics, redox reactions, and acidity and salinity processes. Pre: CSES 3114, CSES 3124, CHEM 2514 or CHEM 2535, CHEM 3114, (MATH 2015 or MATH 1026). (3H,3C)

#### 4764 (CSES 4764): BIOREMEDIATION

Overview of environmental biotechnology and the use of microbes and other organisms to remove contaminants and improve environmental quality. Topics include treatment of contaminated soils, waters, and wastewaters, as well as remediation of industrial waste streams. Pre: BIOL 2604. (3H,3C)

#### 4774 (CSES 4774): RECLAMATION OF DRASTICALLY DISTURBED LANDS

Remediation, rehabilitation, revegetation strategies for lands disturbed by mining, construction, industrialization, and mineral waste disposal. Disturbed site characterization and materials analysis procedures. Regulatory and environmental monitoring frameworks for mining sites and other disturbed lands. Prediction and remediation of water quality impacts from acid drainage. Pre: CSES 3114 or ENSC 3114 or GEOS 3614 or CSES 3134 or ENSC 3134 or CSES 3304 or GE OG 3304 or GEOS 3304. (3H,3C)

#### 4854 (CSES 4854): WETLAND SOILS AND MITIGATION

Wetland soils as components of natural landscapes: biogeochemistry, hydrology, geomorphology, hydric soil indicators, and wetland functions under various land uses. Soil and hydrologic factors important to wetland delineation and jurisdictional determination. Mitigation of wetland impacts with emphasis on restoration and creation. Outdoor lectures at local wetlands and a two-day long field trip to observe and identify wetlands soils are mandatory. Pre: (CSES 3114, CSES 3124) or (ENSC 3114, ENSC 3124) or (GEOS 3614, GEOS 3624) or CSES 3134 or ENSC 3134. (2H,3L,3C)

#### 4864: CAPSTONE: ENV SCIENCE

Discussion based learning that utilizes prior knowledge gained in the major to synthesize information, and prepare a written comprehensive work plan. The work plan will demonstrate the student's understanding of contaminant fate and mobility in different environmental media and will be defended orally. Review and explore available careers in environmental science through seminars and working groups within environmental professionals discussing the role and responsibilities of environmental scientists in industry, consulting, regulatory agencies, and non-profits. ENSC majors only. Senior Standing. Pre: (CSES 3634 or ENSC 3634), (ENSC 4414), (CHEM 4734 or CSES 4734 or ENSC 4734), (CSES 4854 or ENSC 4854). (3L,1C)

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Entomology

### Overview

### [Undergraduate Course Descriptions \(ENT\)](#)

**Head:** Loke T. Kok

**Professors:** J.C. Bergh, C. C. Brewster, D. A. Herbert Jr., L. T. Kok, T. P. Kuhar, D. M. Miller, D. G. Pfeiffer, S. M. Salom, P. B. Schultz, and M. J. Weaver

**Associate Professors:** Z. N. Adelman, K. M. Myles, S. L. Paulson, and I. V. Sharakhov

**Assistant Professors:** T. D. Anderson and P. Marek

Web: [www.ento.vt.edu](http://www.ento.vt.edu)

## Overview

Entomology is both a basic and an applied science which deals with the study of insects and their effects upon the health, economy, and welfare of humankind.

The department offers graduate programs leading to the M.S.L.F.S. (thesis or non-thesis) and Ph.D. (see Graduate Catalog). The departmental teaching, research, and extension programs are closely coordinated with those of other departments.

Insects are important as agricultural, health, and aesthetic pests and as beneficial organisms which serve as pollinators, biological control agents for pest populations, and as components of natural ecosystems. While entomologists have only scratched the surface in the study of insects and related arthropods, their research has yielded great benefits to humankind. Examples include reductions in human diseases transmitted by insects and the leadership shown by entomologists in the development of integrated pest management principles and procedures.

## [Undergraduate Course Descriptions \(ENT\)](#)



#### 1084: CAREERS IN ENTOMOLOGY

A comprehensive introduction of post-baccalaureate professional opportunities requiring knowledge of entomology including agricultural, medical and public health; forest and natural ecosystems; education and outreach; engineering and material science; biodiversity and evolution of arthropods. (1H,1C)

#### 2004: INSECTS AND HUMAN SOCIETY

An appreciation of the past, present and future role of insects with human society. Includes how to identify common insects and other arthropods, the effects of insects on human history; diseases transmitted by insects and their worldwide impact; insects and their influence on our language, literature, and the arts; management of pests of plants, animals, and its effects on environmental pollution; and practical information of how to recognize and manage important insects and arthropods, such as termites in houses and fleas on animals. (3H,3C) I,II,III,IV.

#### 2254: BEES AND BEEKEEPING

An introduction to honey bee biology, the social organization of the honey bee colony and to modern apiculture, including the use of bees for pollination. Topics on beekeeping include equipment, how to get started, and colony management practices. (2H,2C) II.

#### 2264: BEES AND BEEKEEPING LABORATORY

A laboratory course which examines the principles and practices of modern apiculture as they relate to honey bee biology. An emphasis is placed on students gaining practical field experience in modern management techniques. Co: 2254. (3L,1C) II.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3014 (BIOL 3014): INSECT BIOLOGY

Insect biology provides an introduction to the science of entomology. The course covers the diversity of insects, their biology and behavior, the importance of insects and insect control programs in agriculture, and the effects that insects have had on human history and culture. Laboratory (3024) is optional. Pre: (BIOL 1005, BIOL 1006) or (BIOL 1105, BIOL 1106) or (BIOL 1205H, BIOL 1206H). (2H,2C)

#### 3024 (BIOL 3024): INSECT BIOLOGY LABORATORY

Taxonomy and ecology of insects commonly encountered. Identification of all orders and many common families. Ecological attributes of each taxon, including food, habitat, life cycle, and behavior. An insect collection is required. I Pre: (BIOL 1005, BIOL 1006) or (BIOL 1105, BIOL 1106) or (BIOL 1205H, BIOL 1206H). Co: 3014. (1H,3L,2C)

#### 3254 (BIOL 3254): MEDICAL AND VETERINARY ENTOMOLOGY

An introduction to the roles of insects and other arthropods in the direct causation of disease in humans and animals, and as vectors in the transmission of disease organisms. The epidemiology and replication cycles of vector-borne pathogens with major medical and veterinary importance will be examined. Information will be provided on the biology and behavior of disease vectors and external parasites, and on the annoying and venomous pests of humans and animals. Mechanisms of control will be discussed. Pre: (BIOL 1005, BIOL 1006) or (BIOL 1105, BIOL 1106) or (BIOL 1205H, BIOL 1206H). (3H,3C)

#### 3264 (BIOL 3264): MEDICAL AND VETERINARY ENTOMOLOGY LABORATORY

Taxonomy and anatomy of insects and arthropods of medical and veterinary importance. Examination of feeding behavior and ecology. Emphasis on the mechanism of injury or pathogen transmission by each group. Pre: (BIOL 1105, BIOL 1106) or (BIOL 1005, BIOL 1006) or (BIOL 1205H, BIOL 1206H). Co: 3254. (3L,1C)

#### 4254: INSECT PEST MANAGEMENT

Principles of insect pest management with application to the major insect pests found in Virginia. Pest management involves the utilization of all effective control practices in a program which is ecologically

and economically efficient. This course is intended for all students with an interest in efficient agricultural production and in reducing losses to our most diverse competitor. One year of General Biology required. (2H,3L,3C) II.

4264 (PPWS 4264): PESTICIDE USAGE

An interdisciplinary study of pesticides used in urban and agricultural environments. Topics studied will include: classification, toxicology, formulation, application techniques, safety, legal considerations, environmental impact, and research and development of new pesticides. Pre: CHEM 2515 or CHEM 2536. (2H,3L,3C) II.

4354 (BIOL 4354): AQUATIC ENTOMOLOGY

Biology and taxonomy of insects and other macroinvertebrates most commonly encountered in freshwater environments. Selected aspects of biology, such as habitat, feeding, locomotion, and life history. Identification of individual taxa, mostly at family and genus level. Significance of these organism in aquatic ecology, pollution monitoring, and natural resource management. Pre: (BIOL 1005, BIOL 1006), (BIOL 1015, BIOL 1016) or (BIOL 1105, BIOL 1106, BIOL 11 15, BIOL 1116). (3H,3L,4C)

4484 (BIOL 4484) (FIW 4484): FRESHWATER BIOMONITORING

Concepts and practices of using macroinvertebrates and fish to monitor the environmental health of freshwater ecosystems. Effects of different types of pollution and environmental stress on assemblages of organisms and underlying ecological principles. Role of biological studies in environmental regulation. Study design, field and laboratory methods, data analysis and interpretation, verbal and written presentation of results. Pre: (BIOL 2804), (BIOL 4004 or BIOL 4354 or ENT 4354 or FIW 4424 or FIW 4614). (3H,3L,4C)

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Engineering Science and Mechanics

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**Department Head:** Pamela Vandevord (Interim)

**Harry C. Wyatt Professor:** S. M. Duma

**Clifton C. Garvin Professor:** R. C. Batra

**Adhesive and Sealant Science Professor:** D. A. Dillard

**Paul and Dorothea Torgersen Dean's Chair in Engineering Professor:** R. Benson

**Tucker Professor:** R. L. Mahajan

**Professors:** S.W. Case, M. S. Cramer, R. Davalos, H.C. Gabler, R. Gourdie, M.R. Hajj, J.J. Lesko, S.H. McKnight, S.A. Ragab, M.A. Stremmler, and P. Vandevord

**Associate Professors:** R. De Vita, S.L. Hendricks, S. Jung, S. LaConte, Y.W. Lee, S. Poelzing, R. Queen, S. D. Ross, J. J. Socha, A.E. Staples, S. Thangjitham, C.D. Untaroiu, M. Van Dyke, and V.M. Wang

**Assistant Professors:** N. T. Abaid, J. B. Boreyko, G. Cao, J. Chappell, J.A. Hanna, A. Kemper, A. Morozov, S. Rowson, S. Shahab, A. Untaroiu, and S. Verbridge

**Instructors:** C. Burgoyne, T.S. Chang, N. Johnson, J.K. Lord, and H. Pendar

**Professors Emeritus:** N.E. Dowling, D. Frederick, J.W. Grant, R.A. Heller, M.W. Hyer, R.M. Jones, L.G. Kraige, L. Meirovitch, A.H. Nayfeh, D. Post, K.L. Reifsnider, D.J. Schneck, D.P. Telionis, and H.W. Tieleman

**Affiliate Faculty:** T. Furukawa, S. Huxtable, S. Johnson, R. Kapania, T. Long, R. Muller, A. Nain, M. Nussbaum, A. Onufriev, R. Parker, M. Patil, G. Seidel, S. Taheri, P. Tarazaga, L. Winfrey, C. Woolsey, and R. Yoon

**Academic and Career Advisor:** A. Stanley

Web: [www.esm.vt.edu](http://www.esm.vt.edu)

## Overview

Mechanics is a fundamental area of science and engineering. It is an exciting, expanding field of learning with its roots grounded in the laws of motion formulated by Newton and the principles governing the behavior of solids and fluids, branching out in modern times into interdisciplinary fields such as new engineering materials (adhesives, composites, polymers, light metals), biomechanics, transportation, wind engineering, and vehicular structures. Although the problems to which they are applied may change, the basic principles of mechanics remain current and relevant.

The Department of Engineering Science and Mechanics has a rich tradition for providing an interdisciplinary engineering education. We strive to prepare our graduates to succeed in advanced graduate or professional study, industry, and government. In these activities, our alumni will:

- Apply fundamentals of engineering mechanics and related areas of applied science to define, model, and solve a wide range of engineering problems.
- Apply fundamental mathematical and scientific principles, as well as computational and experimental techniques, to the demands of engineering and scientific practice.
- Function on and lead teams that engage in new areas of research and development in engineering, particularly those that cross the boundaries of traditional disciplines.
- Maintain high productivity and high ethical standards.
- Continually enhance their knowledge throughout their careers.
- Communicate effectively to a broad range of audiences.

These educational objectives are supported by a curriculum that provides its graduates with:

- an ability to apply fundamental knowledge of mathematics, science, and engineering
- an ability to design and conduct mechanics experiments
- an ability to analyze and interpret experimental and computational mechanics data
- an ability to design a system, component, or process to meet desired needs by synergistically combining mechanics of materials, fluid mechanics, and dynamics, when necessary
- an ability to effectively function as the leader, or member, of a multi-disciplinary team
- an ability to identify, formulate, and solve engineering problems involving mechanics of materials, fluid mechanics, and/or dynamics
- an understanding of professional and ethical responsibility
- an ability to communicate effectively “orally, graphically, and in writing
- the broad education necessary to understand the impact of engineering solutions on society and the environment
- a recognition of the need for, and an ability to engage in, life-long learning and accomplishment
- a knowledge of contemporary issues (e.g., social, political, technical, economic, etc.)
- a fundamental understanding that will enable the appropriate use and development of the techniques, skills, and modern engineering tools necessary for engineering practice
- a recognition of the importance of safety in phases of engineering design and practice

A total of 12 credit hours of technical electives and 6 credit hours of senior design give the student freedom to develop individually tailored programs of concentrated study. The department has emphasis areas in Biomechanics, Engineering physics, Fluid mechanics, Motions, or Solid mechanics. Exposure to the design process exists throughout the curriculum, culminating in a senior level capstone design course. The department offers official university degree options in Biomechanics and Engineering Physics.

The Cooperative Education Program is available to qualified candidates at undergraduate and graduate levels.

Undergraduate courses in engineering science and mechanics are taught on a service basis for all engineering curricula. A minor in engineering science & mechanics is available. The department offers graduate programs leading to M.S. (thesis and non-thesis option), M.Eng., and Ph.D. The department

also participates in the Accelerated Undergraduate/Graduate Degree Program. Students with an interest in this program should contact the department for additional information.

The Engineering Science and Mechanics program at Virginia Tech is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Undergraduate Course Descriptions (BMES)

### 2104: INTRODUCTION TO BIOMEDICAL ENGINEERING

Methods of mathematical modeling and engineering analyses related to human physiology. Emphasis placed on fundamental concepts such as biomaterials, biomechanics, tissue engineering, biomedical imaging and nanomedicine. Broad spectrum of current biomedical engineering research areas. Pre: (ENGE 1104 or ENGE 1114 or ENGE 1216), PHYS 2305. Co: MATH 2214. (3H,3C)

### 2984: SPECIAL STUDY

Variable credit course.

### 3124: INTRODUCTION TO BIOMECHANICS

Basic principles of biomechanics. Basic musculoskeletal anatomy. Application of classical mechanics to biological systems. Emphasis placed on mechanical behavior (stress and strain), structural behavior, motion, and injury tolerance of the human body. Biomechanics of medical devices and implants. Advances in safety equipment used in automotive, military, and sports applications. Pre: 2104, ESM 2204, ESM 2304. (3H,3C)

### 3134: INTRODUCTION TO BIOMEDICAL IMAGING

Introduction to major biomedical imaging modalities. Emphasis on X-rays, computerized tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), ultrasound, and optical imaging. Essential physics and imaging equations of the imaging system. Sources of noise and primary artifacts. Patient safety and clinical application. Pre: 2104, (MATH 2204 or MATH 2204H), PHYS 2306. (3H,3C)

### 3144: BIOMEDICAL DEVICES

Design and uses of biomedical devices for diagnosis and therapy of human and animal diseases. Disease etiologies, progression, risk factors, and epidemiology. Tissue, organ, and systems dysfunction and failure and relevance to life stages (pediatric, adolescent, adult, aged). Useful characteristics of engineered materials for device fabrication, including biocompatibility. Gaps between medical needs and current medical devices. Pre: 2104. (3H,3C)

### 4064 (BMVS 4064): INTRO MED PHYSIOLOGY

An introductory to the principles of medical physiology. Designed primarily for (but not limited to), undergraduate students minoring in biomedical engineering, and other related engineering and physical sciences majors with little or no formal background in biological sciences. Basic principles and concepts

of human physiology. Special emphasis on the interactions of human systems biology in their entirety rather than individual genes and pathways. Pre: Junior standing or permission of instructor. (3H,3C)

#### 4134: GLOBAL, SOCIETAL, AND ETHICAL CONSIDERATIONS IN BIOMEDICAL ENGINEERING

Overview of contemporary technological advances to improving human health. Comparison of healthcare systems, problems, and existing solutions throughout the developed and developing world. Consideration of legal and ethical issues associated with developing and implementing new medical technologies. Recognition and definition of gaps between medical needs and current methods and therapies between developed and developing countries. Conceptually design a novel technology. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (ESM)

#### 2014: PROFESSIONAL DEVELOPMENT SEMINAR FOR ESM STUDENTS

Topics designed to foster the professional development of the ESM student. ESM program objectives and outcomes. Overview of solid mechanics, fluid mechanics, and dynamics. Synergistic applications in biotechnology, adhesion science, and other applied areas. (1H,1L,1C)

#### 2104: STATICS

Vector mechanics of forces and moments, free-body diagrams, couples, resultants, equilibrium of particles and rigid bodies in two and three dimensions, forces in trusses, frames, and machines, centroids, centers of mass, distributed forces, internal shear forces and bending moments in beams, shear and moment diagrams, friction, belt friction, area of moments of inertia, parallel axis theorem. Course requirements may be satisfied by taking MATH prerequisite prior to or concurrent with course. Corequisites: (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H or MATH 2406H) (3H,3C)

#### 2204: MECHANICS OF DEFORMABLE BODIES

Concepts of stress, strain, and deformation. Factor of safety. Stress-strain relationships and material properties. Stress concentrations. Area moments of inertia. Axially loaded members, torsionally loaded members, bending of beams. Shear and moment diagrams. Stresses due to combined loading. Thin-walled pressure vessels. Transformation of stress including Mohr's circle. Beam deflections and buckling stability. Pre: 2104, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). (3H,3C)

#### 2214: STATICS AND MECHANICS OF MATERIALS

Forces, moment, resultants, and equilibrium. Stress, strain, and stress-strain relations. Centroids and distributed loads. Analysis of axially loaded bars and beams. Principal stresses and Mohr's circle, combined loading. Pressure vessels and buckling of columns. Partially duplicates 2104 and 2204. Must be CHE major. Co: MATH 2224. (3H,3C)

#### 2304: DYNAMICS

Vector treatment of the kinematics and kinetics of particles and rigid bodies, Newton's laws, work and energy, impulse and momentum, impact, mass moments of inertia, rotating axes. Pre: 2104, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). Co: MATH 2214. (3H,3C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 2994H: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3024: INTRODUCTION TO FLUID MECHANICS

Fluid properties and hydrostatics. Derivation and application of the continuity, momentum, and energy equation (Bernoulli's equation) for ideal and real fluid flow (laminar or turbulent). Dimensional analysis and similitude. Introduction to boundary layers, lift and drag. Pre: 2304, (MATH 2224 or MATH 2204 or MATH 2204H). (2H,2L,3C)

#### 3034: FLUID MECHANICS LABORATORY

Introduction to experimental fluid mechanics. Dimensional analysis. Experiments on fluid properties, flow measurements, and flow visualization, including manometry, determining hydrostatic forces on submerged surfaces, applications of the impulse-momentum principle, velocity measurements, measuring drag forces, quantifying flow in channels. Modern data acquisition techniques. Pre: 2304, ECE 3054. Co: 3234. (3L,1C)

#### 3054 (MSE 3054): MECHANICAL BEHAVIOR OF MATERIALS

Mechanical properties and behavior of solid materials subjected to static, cyclic, and sustained loads resulting from stress states, environments, and stress histories typical of service conditions; multiaxial failure criteria; behavior of cracked bodies; fatigue of materials; creep of materials; microstructure-property relationships; design methodologies. Pre: 2204, (MSE 2034 or MSE 2044 or MSE 3094 or AOE 3094 or CEE 3684). (3H,3C)

#### 3064 (MSE 3064): MECHANICAL BEHAVIOR OF MATERIALS LABORATORY

Laboratory experiments on behavior and mechanical properties of solid materials. Tension, compression, bending, hardness, nano-indentation, and impact tests; behavior of cracked bodies; fatigue and crack growth tests; creep deformation; microstructure-property relationships; laboratory equipment, instrumentation, and computers. Pre: 2204. Co: 3054. (3L,1C)

#### 3114: PROBLEM DEFINITION AND SCOPING IN ENGINEERING DESIGN

Define open-ended engineering design projects, identify relevant broad social, global, economic, cultural and technical needs and constraints, determine ways in which technical skills contribute to addressing complex engineering design challenges. Identify a capstone project for ESM 4015-4016. Pre-requisite: Junior standing in ESM. Pre: 2014. (2L,1C)

#### 3124: DYNAMICS II- ANALYTICAL AND 3-D MOTION

Review of Newton's Laws, introduction to Lagrange's equations, rotating coordinate systems, particle dynamics, systems of particles, rigid-body dynamics, small amplitude oscillations, holonomic and nonholonomic constraints, phase space and energy methods. Pre: 2304, MATH 2214, (MATH 2224 or MATH 2204 or MATH 2204H). (3H,3C)

#### 3134: DYNAMICS III - VIBRATION AND CONTROL

Single-degree-of-freedom vibration, n-degree-of-freedom systems, continuous systems, nonlinear systems, system stability, introduction to the feedback control of dynamic systems. Pre: 3124, MATH 4564. (3H,3C)

#### 3154: SOLID MECHANICS

Introduction to tensors, mathematical description of deformations and internal forces in solids, equations of equilibrium, principle of virtual work, linear elastic material behavior, solution for linear elastic problems including axially and spherically symmetric solutions, stress function solutions to plane stress and strain problems, solutions to 3-D problems, energy methods. Pre: 2204, (MATH 2214 or MATH 2214H). Co: MATH 4574. (3H,3C)

#### 3234: FLUID MECHANICS I-CONTROL VOLUME ANALYSIS

Fluid statics. Control volume approach to flow analysis: conservation laws, pipe flows, compressible flow, open channel flow. Pre: 2304, PHYS 2306. (3H,3C)

#### 3334: FLUID MECHANICS II-DIFFERENTIAL ANALYSIS

Introduction to continuum mechanics for fluid systems. Fluid kinematics. Differential approach to flow analysis: conservation equations, exact solutions, potential flows, viscous flows. Pre: 3234. Co: MATH 4574. (3H,3C)

#### 3444: MECHANICS LABORATORY

Concepts in instrumentation, data acquisition, and signal analysis. Measurements of mechanics quantities and phenomena associated with solid, fluid, and dynamical systems. Open-ended problem definition and approach formulation. Application and synthesis of engineering mechanics fundamentals to the modeling and solution of open-ended problems. Group-working skills and effective written and oral communication. Pre: 3234, 3034, 3054, 3064, 3124, ECE 3054. Co: 3134, 3334, 3154. (1H,3L,2C)

#### 3704: BASIC PRINCIPLES OF STRUCTURES

Static equilibrium of forces and moments, concurrent and nonconcurrent force systems, center of gravity, concentrated and distributed loads. Solution of trusses. Stress and strain, elastic behavior of materials, cables and arches, shear, bending, and deformation in beams, indeterminate structures. Not available to students in engineering. (3H,3C)

#### 4014: APPLIED FLUID MECHANICS

Analysis of flow over practical configurations, panel methods, Reynolds-averaged Navier-Stokes equations, turbulent boundary layers, flow separation and three-dimensional effects. Unsteady flows, fluid-structure interactions. Pre: 2074, 3016. (3H,3C)

#### 4015-4016: CREATIVE DESIGN AND PROJECT I, II

Design of engineering systems and projects encompassing the principles and practices of engineering science and of the several engineering fields. Investigation and report on a supervised design project. Senior standing required. Instructor consent. Pre: 3114 for 4015; 4015 for 4016. 4015: (2H,3L,3C) 4016: (1H,6L,3C)

#### 4024: ADVANCED MECHANICAL BEHAVIOR OF MATERIALS

Mechanical behavior of materials, emphasizing solid mechanics aspects and methods for predicting strength and life of engineering components. Plasticity, failure criteria, fracture mechanics, crack growth, strain-based fatigue, and creep. Microstructure-property relationships, and laboratory demonstrations. Pre: 3054 or MSE 3054. (3H,3C)

#### 4044: MECHANICS OF COMPOSITE MATERIALS

Introduction to the deformation, stress, and strength analysis of continuous-fiber-polymer-matrix laminated composites. Fabrication, micromechanics of stiffness and expansional coefficients, classical lamination theory (CLT). Environmentally induced stresses. Computerized implementation and design. Pre: 2204. (3H,3C)

#### 4084 (AOE 4084): ENGINEERING DESIGN OPTIMIZATION

Use of mathematical programming methods for engineering design optimization including linear programming, penalty function methods, and gradient projection methods. Applications to minimum weight design, open-loop optimum control, machine design, and appropriate design problems from other engineering disciplines. Pre: (MATH 2224 or MATH 2204 or MATH 2204H). (3H,3C)

#### 4105-4106: ENGINEERING ANALYSIS OF PHYSIOLOGIC SYSTEMS

Engineering analysis of human physiology. Physiologic systems are treated as engineering systems with emphasis input-output considerations, system interrelationships and engineering analogs. 4105 - Mass and electrolyte transfer, nerves, muscles, renal system. 4106 - cardiovascular mechanics, respiratory system, digestive systems, senses. Pre: 2304, MATH 2214. (3H,3C)

#### 4114: NONLINEAR DYNAMICS AND CHAOS

Motion of systems governed by differential equations: stability, geometry, phase planes, bifurcations, Poincaré sections, point attractors, limit cycles, chaos and strange attractors, Lyapunov exponents. Forced, nonlinear oscillations: jump phenomena, harmonic resonances, Hopf bifurcations, averaging and multiple-scales analysis. Systems governed by discrete maps: return maps, cobweb plots,



period-multiplying bifurcations, intermittency, delay coordinates, fractal dimensions. Pre: (2304 or PHYS 2504), (MATH 2214 or MATH 2214H). (3H,3C)

#### 4154: NONDESTRUCTIVE EVALUATION OF MATERIALS

Concepts and methods of nondestructive evaluation of materials. Discussion of techniques and mathematical bases for methods involving mechanical, optical, thermal, and electromagnetic phenomena; design for inspectability; technique selection criteria; information processing and handling; materials response measurement and modeling; signal analysis. Pre: 3054, (PHYS 2206 or PHYS 2306). (3H,3C)

#### 4194 (ME 4194): SUSTAINABLE ENERGY SOLUTIONS FOR A GLOBAL SOCIETY

Addresses energy metrics, global and US energy supply and demand, transitional energy sources (natural gas, petroleum, coal, nuclear), sustainable/renewable source (solar, geothermal, hydro, tidal, wind, biofuels), and methods for increasing efficiencies (energy storage, batteries, green building, conservation). Options for transportation, electricity, lighting and heating needs of industry, agriculture, community, and citizens. Production, transmission, storage, and disposal issues considered in the context of global political, economic, and environmental impacts. Senior Standing in major may be substituted for pre-requisite ENGL 3764. Pre: (CHEM 1035 or CHEM 1055), PHYS 2306, ENGL 3764. (3H,3C)

#### 4204: 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. Pre: 2304, (2074 or ME 2004). (3H,3C)

#### 4224: BIODYNAMICS AND CONTROL

Study of human movement dynamics and neuromuscular control of multi-degree-of-freedom systems. Computational simulation of forward-dynamics and state-space linear control of human movement to investigate functional performance and neuromuscular pathology. Pre: 3124, 4204. (3H,3C)

#### 4234: MECHANICS OF BIOLOGICAL MATERIALS AND STRUCTURES

Anatomy and physiology of connective tissue. Techniques for determining the mechanical response of biological soft and hard tissues. Includes static, viscoelastic, creep, fatigue, and fracture. Simplified models of biological structures. Creation of geometric models from medical imaging and computational modeling. Specific topics may include bone, cartilage, ligaments, tendon, teeth, and skin. Pre: 3054, (2074 or ME 2004). (3H,3C)

#### 4245,4246: MECHANICS OF ANIMAL LOCOMOTION

4245: Mechanical and biological principles of terrestrial animal locomotion, including walking, running, jumping, climbing, burrowing, and crawling. Terrestrial locomotion-based bio-inspired design. 4246: Mechanical and biological principles of animal locomotion in fluids, including active and gliding flight, swimming, jetting, and running on water. Engineering design inspired by fluid based biological locomotion. Pre: 3054 for 4245; 3015 for 4246. (3H,3C)

#### 4304: HEMODYNAMICS

Study of the human cardiovascular system and blood flow. Anatomy and physiology of the human heart, vascular system, and its organization. Blood physiology and rheology. Non-Newtonian blood flow models. Steady and pulsatile blood flow in rigid and elastic arteries. Pressure waves in elastic arteries. Three-dimensional blood flow in the aortic arch and flow around heart valves. Pre: 3334 or ME 3404. (3H,3C)

#### 4404: FUNDAMENTALS OF PROFESSIONAL ENGINEERING

A refresher of basic principles and problem solving techniques involving twelve subject areas most common to all engineering curricula. The topics include those tested by the National Council of Engineering Examiners on the EIT (Engineer in Training) examination, the first requirement, in all fifty states, toward P.E. (Professional Engineer) licensing. Duplicates material of other engineering courses and impracticable for non-engineers, hence not usable for credit toward any degree. Pre: Junior and senior standing in Engineering or in Building Construction or Graduate students in Engineering. Pass/Fail only. (2H,2C)

#### 4444 (AOE 4054) (CEE 4444): STABILITY OF STRUCTURES

Introduction to the methods of static structural stability analysis and their applications. Buckling of columns and frames. Energy method and approximate solutions. Elastic and inelastic behavior. Torsional and lateral buckling. Use of stability as a structural design criterion. Pre: AOE 3024 or CEE 3404. (3H,3C)

#### 4614: PROBABILITY-BASED MODELING, ANALYSIS, AND ASSESSMENT

Uncertainty analysis of engineering data, parameters estimation, probability concepts, random variables, functions of random variables, probability-based performance functions and failure modes, risk and reliability functions, probability of failure and safety index, random sequences and stochastic processes, correlation functions and spectral densities, return period and extreme values, failure rates, performance monitoring and service life prediction. Pre: 2204. (3H,3C)

#### 4734 (AOE 4024): AN INTRODUCTION TO THE FINITE ELEMENT METHOD

The finite element method is introduced as a numerical method of solving the ordinary and partial differential equations arising in fluid flow, heat transfer, and solid and structural mechanics. The classes of problems considered include those described by the second-order and fourth-order ordinary differential equations and second-order partial differential equations. Both theory and applications of the method to problems in various fields of engineering and applied sciences will be studied. Pre: (CS 3414 or MATH 3414 or AOE 2074), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). (3H,3C)

#### 4904: PROJECT AND REPORT

Variable credit course. X-grade allowed.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Finance, Insurance, and Business Law

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**Head:** Vijay Singal

**Suntrust Professor of Finance:** G.E. Morgan

**Suntrust Professor of Banking:** J.M. Pinkerton

**J. Gray Ferguson Professor of Finance:** V. Singal

**Alumni Distinguished Professor and R. B. Pamplin Professor of Finance:** A.J. Keown

**R. B. Pamplin Professor of Finance:** G.B. Kadlec

**R.V. and A.F. Oliver Professor of Investment Management:** R. Kumar

**R.E. Sorensen Professor:** J. Hiller

**Wells Fargo Professor in Financial Risk Management:** S. Mansi

**Professors:** D.M. Patterson

**Emeritus Professors:** D. Shome and G.R. Thompson

**Associate Professors:** R.S. Billingsley, V.A. Bonomo, J.C. Easterwood, and U. Lei

**Assistant Professors:** D. Anginer, A. MacKinlay, B. Pay, T. Wang, and J. Xu

**Professor of Practice:** M. Kender

**Associate Professor of Practice:** D. Klock and C. Spicer

**Assistant Professor of Practice:** J. Malone

**Visiting Assistant Professors:** P. Ye

**Instructors:** B. Hart, K. Hogan, E. Johnsen, M. Jones, W. Newton, J. Showalter, and K. Sullivan

Web: [www.finance.pamplin.vt.edu](http://www.finance.pamplin.vt.edu)

E-mail: [fin@vt.edu](mailto:fin@vt.edu)



## Overview

Finance is a specialty that works with the development, allocation and use of monetary resources within established legal and ethical frameworks, while understanding and mitigating the associated risks. Money is a critical component of the economic system and its flow is the sustaining force of the U.S. and global economy. Therefore, in working with how governments, corporations, intermediaries, and households utilize their financial assets finance professionals are an integral part of how the economy perpetuates the standard of living that we enjoy.

Traditionally there are three separate but related fields within finance: 1) corporate financial management or "business finance" which focuses on the internal decisions of companies to raise funds and invest in corporate assets; 2) investment management which focuses on the purchase and sale of stocks and bonds or their derivatives by individuals and institutions; and 3) financial services management, which focuses on the management and regulation of institutions and the role that financial institutions play in the economy.

The undergraduate program in Finance meets the requirements of students who desire specialized careers in financial management. Students gain expertise in both accounting and finance, essential for success as a financial professional. The case-oriented focus of coursework requires students to apply their knowledge and strengthen their oral and written communication skills. The department offers specializations in (i) Corporate Financial Management, (ii) Investment Management and CFA® (Chartered Financial Analyst), based on the CFA® curriculum as recognized and approved by the CFA Institute, (iii) Banking and Financial Institutions Management, (iv) Financial Accounting, and (v) CFP® Certification Education with approval of CFP Board of Standards. Students also have the opportunity to participate in student management funds focused on investments in bonds (BASIS) and in stocks (SEED).

The curriculum offers courses in finance, insurance, and business law, but a major only in finance.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all

requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

Students select different combinations of elective courses to fulfill the requirements of one or more of the six options offered. The six options are: (i) Corporate Financial Management, (ii) Investment Management and CFA® (Chartered Financial Analyst), (iii) Banking and Financial Institutions Management, (iv) Financial Accounting, and (v) CFP® Certification Education with approval of CFP Board of Standards

## Undergraduate Course Descriptions (FIN)

### 2104 (AAEC 2104): PERSONAL FINANCIAL PLANNING

Survey of fundamental personal financial planning needs and decisions of young professionals.

Introduction to the personal financial planning needs that special household circumstances or non-traditional household situations may precipitate. (3H,3C)

### 2114: INVESTMENTS & FINANCIAL LITERACY

Examines the investment process; the financial markets; investing in common stock, bonds, and mutual funds; budgeting; long- and short-term borrowing; credit card debt; student loan debt; insurance; major financial decisions, and retirement planning. Coverage of time value of money and risk and return to provide fundamental tools for valuation and financial decision-making. (3H,3C)

### 2164: SURVEY OF FINANCE AND CAREER PLANNING

Career opportunities and job search strategies in the finance field with reference to the finance courses that best help the student identify a career in his/her selected field. Pass/Fail only. Pass/Fail only. (1H,1C)

### 2954: BUSINESS STUDY ABROAD

This course provides students with an international business experience. It is only offered as part of a program outside of the United States. Students will learn from the structured educational experience developed by the faculty leader. Pre: Instructor's consent and the completion of 30 SH with a minimum GPA of 3.0 or departmental consent. Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3054: LEGAL AND ETHICAL ENVIRONMENT OF BUSINESS

Key concepts of law, ethics, and regulation applicable to business operations and management; includes international aspects. Legal and ethical decision-making, critical applications, and relationship of business to society. Legal systems, torts, contracts, property, administrative law topics, agency, ethical frameworks. Pre: Junior Standing. (3H,3C)

### 3074: LEGAL, ETHICAL, AND FINANCING ISSUES FOR ENTREPRENEURS

Introduction of key legal, ethical, and financing topics for new ventures. Ethical decision making in entrepreneurial situations. Choosing among legal entities for financing and ownership goals. Company governance. Creating and protecting intellectual property. Identifying and choosing financing options for new ventures. Employment issues for entrepreneurial firms. Basics of contracts. Enterprise risk management and compliance. Exit strategies. Partially duplicates FIN 3054 (Legal and Ethical Environment of Business). Students may not receive credit for both courses. Junior Standing. (3H,3C)

### 3104: INTRODUCTION TO FINANCE

Overview of financial decision-making process focusing on the creation of wealth. Topics covered include the time value of money, how stocks and bonds are valued, financial decision-making within a firm, an overview of financial markets, and investment banking. The course is designed for finance and non-finance majors. Pre: ACIS 2115, (BIT 2405 or STAT 3005 or STAT 3604 or STAT 4604 or STAT 4705 or STAT 4714) or (STAT 3615, STAT 3616), (ECON 2005 or ECON 2025H). (3H,3C)

#### 3134: FINANCIAL ANALYTICS

This course provides an understanding of the theory and practice of making financial decisions for corporations. Key concepts and computational skills in finance. Time value of money, risk and return, security valuation and interest rate determination. Pre: (ECON 2005 or ECON 2025H), ACIS 2115, (BIT 2405 or STAT 3005 or STAT 3604 or STA T 4604 or STAT 4705 or STAT 4714 or STAT 3615, STAT 3616). Co: ACIS 2504. (3H,3C)

#### 3144: INVESTMENTS: DEBT, EQUITY AND DERIVATIVES

Risk, return and portfolio theory, knowledge of financial securities and markets. Introduction to mutual funds, financial securities and markets, portfolio analysis, market efficiency and performance evaluation, bond valuation, term structure of interest rates, interest rate risk, security analysis and stock valuation, options, Black-Scholes option pricing model, and futures. Must have a grade of C or better in prerequisite of FIN 3134, and Junior standing required. Pre: 3134. (3H,3C)

#### 3154: CORPORATE FINANCE

Types of financial management decisions that firms make, the environment in which decisions are made, the available choices and decision criteria, and valuation consequences of these choices. Determination of a firm's optimal debt- equity ratio, estimation of cost of capital, evaluation of capital investments, dividend policy, and sources of financing. Must have a grade of C or better in prerequisite of FIN 3134, and Junior standing required. Pre: 3134. (3H,3C)

#### 3174: FINANCE CAREER STRATEGIES

Analysis and research of career opportunities in financial industry. Study of future trends in careers in financial industry. Development of short and long-term career goals. Building and developing a professional network. Identify types of finance interviews. Ethical negotiation of job offers. (1H,1C)

#### 3204: RISK AND INSURANCE

Surveys the concept of risk as it applies to the nuclear family and as a socio-economic force in society. Risk management techniques utilizing social and proprietary insurance to neutralize the effect of risks inherent in daily life: termination or suspension of earnings, liability exposures, and potential losses of real and personal property values. Junior standing required. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4004: WILLS, TRUSTS, AND ESTATES

Examines the control of assets through the creation and use of trusts, and the control of property through estate planning. The course emphasizes financial planning through estate management both personally and as a part of a business plan. Pre: 3055 or 3054 or 3074. (3H,3C)

#### 4014: INTERNET, ELECTRONIC AND ONLINE LAW

Study of the international legal environment and regulation of the electronic world, including electronic commerce, computer and media communication issues, and speech over the Internet. Webpage design, copyright, electronic payment, electronic contract, encryption, and privacy are some issues to be examined. Topics will be updated continually to reflect the newest developments of the law as applied to the electronic world of commerce. Pre: Junior/Senior standing or consent of instructor. (3H,3C)

#### 4114 (AAEC 4114): FINANCIAL PLANNING TECHNOLOGY & MODELING

Use of professional software applications that support financial planning analyses, plan preparation, wealth management, and client relationships. Principles of personal investment portfolio research, construction, and performance applied to comprehensive financial planning and wealth management. Pre: AAEC 3104, FIN 3144. (3H,3C)

#### 4144: INTERNATIONAL FINANCIAL MANAGEMENT

Explores the environmental challenges facing the financial manager of a multinational corporation and the tools and techniques developed to meet such challenges. Pre: 3104. (3H,3C)

#### 4154: REAL ESTATE FINANCE

This course introduces the fundamentals of both real estate financing and investment. Conventional mortgages as well as more creative financing methods will be analyzed. The secondary market for mortgages and relevant institutional factors also will be examined. Investment analysis of real estate will be viewed in a capital budgeting framework; appropriate tax law will be discussed as it affects real estate cash flows. Pre: 3134. (3H,3C)

#### 4214: ADVANCED PROPERTY & LIABILITY INSURANCE

Concepts of finance applied to the construction of models in Excel. Construct models of financial statement to evaluate financial strategies for a firm; design risk/return models for investment portfolio strategies using equity and/or debt securities; build models to optimize bond portfolios including interest rate sensitivities, duration and convexity; develop models to analyze and dynamically hedge option and futures portfolios; assemble binomial tree models on American options; build simulation models to evaluate different types of options. Pre: 3144. (3H,3C)

#### 4224: FIXED INCOME SECURITIES: ANALYSIS AND MANAGEMENT

Analysis of fixed income securities, including corporate bonds, U.S. Treasury notes and bonds, municipal bonds, money market securities, and home mortgages. The analysis include interest rate risk, credit risk, bond valuation theory, and the valuation of embedded options in the bond contract. Theories of the term structure of interest rates are presented. Must have a grade of C or better in prerequisites of FIN 3144 and 3154. Pre: 3144, 3154. (3H,3C)

#### 4225-4226: ANALYTICS FOR FIXED INCOME SECURITIES AND PORTFOLIO MANAGEMENT

4225: Management of fixed income securities in an experiential setting. Bond pricing and investment. Credit analysis and portfolio strategies in fixed income. Introduction to advanced analytical techniques in bond and portfolio analytics. Conduct research on individual companies, industries, and countries. Membership in BASIS (Bond And Securities Investing by Students). Must have a B- or better in prereq. Pass/Fail Only. Pass/Fail only. Pre: 3134 for 4225; 4224, 4225 for 4226. Co: 4224 for 4225. (3H,3C)

#### 4234: VENTURE CAPITAL AND INVESTMENT BANKING

Explores the venture capital cycles 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. Includes a conceptual component and an applied component in which the case method is used. Must have a grade of C or better in prerequisites of FIN 3144 and 3154. Pre: 3144, 3154. (3H,3C)

#### 4244: ASSET VALUATION AND CORPORATE GOVERNANCE

The effect of corporate governance on asset-valuation. Case oriented course focusing on the valuation of non-financial assets such as projects, business units, private and public firms. Topics include method of comparables, discounted cash flow methods and the real options approach to valuation. Examines the external and internal governance mechanisms for preserving and enhancing the value of a firm. Must have a grade of C or better in prerequisites of FIN 3144 and 3154. Pre: 3144, 3154. (3H,3C)

#### 4254: BANK MANAGEMENT AND FINANCIAL SERVICES

The functions of financial service providers and the risks inherent in the provision of banking and other financial services. Regulatory background and issues. Case oriented course. Must have a grade of C or better in prerequisites of FIN 3144 and 3154. Pre: 3144, 3154. (3H,3C)

#### 4264: MANAGING RISK WITH DERIVATIVES

The types, payoff, and pricing of derivative securities and contracts and their application in managing financial risks faced by corporations. Topics include options, forwards, futures and swaps; managing foreign currency risk, interest rate risk, stock price risk, and commodity price risk; and risk management techniques. Must have a grade of C or better in prerequisites of FIN 3144 and 3154. Pre: 3144, 3154. (3H,3C)

#### 4274: EQUITY SECURITIES: ANALYSIS AND MANAGEMENT

Advanced valuation and analysis of equity securities with case applications. Critical analysis of advanced equity asset pricing models. Analysis of advanced equity portfolio management techniques, equity portfolio performance measurement, and equity portfolio performance attribution analysis. Identification and analysis of market anomalies and recent developments in equity analysis. Must have grade of C or better in prerequisites of FIN 3144 and 3154. Pre: 3144, 3154. (3H,3C)

#### 4275-4276: ANALYTICS FOR EQUITY SECURITIES AND PORTFOLIO MANAGEMENT

Selection and management of equity securities in an experimental setting. Analysis, selection, and investment in common stocks. Introduction to advanced analytical techniques in equity evaluation and portfolio analytics. Research individual companies, industries, economic sectors, and national and global macroeconomic trends. Use appropriate software to develop financial models. Present buy and sell recommendations for actual execution in the portfolio. Maintain a high level of fiduciary responsibility. Pass/Fail only. Membership in SEED (Student-Managed Endowment for Educational Development). Pass/Fail only. Pre: 3134 for 4275; 4274, 4275 for 4276. Co: 4274 for 4275. (3H,3C)

#### 4284: FREE MARKETS, INDIVIDUAL FREEDOM, AND ECONOMIC WELFARE

Course exposes students to various viewpoints on the role free markets can and do play in promoting individual freedom. Allocation of scarce resources, and in enhancing welfare. Explores the strengths and weaknesses of capitalism by critically evaluating the relationship between the economic efficiency achieved by capitalism and the attainment of welfare objectives. Other topics include current items such as globalization, price controls, income equality, outsourcing, corporate pricing power through monopoly/oligopoly, and government regulation of the economy. (3H,3C)

#### 4954: STUDY ABROAD

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Fish and Wildlife Conservation

[Fish Conservation](#)

[Wildlife Conservation](#)

[Undergraduate Course Descriptions \(FIW\)](#)

**Head:** Joel Snodgrass

**Professors:** P. L. Angermeier, K.A. Alexander, C. A. Dolloff, J. D. Fraser, C. A. Haas, E. M. Hallerman, W. Hopkins, M.J. Kelly, B.R. Murphy, D. J. Orth, and D. F. Stauffer

**Associate Professors:** J. M. Ford, E. Frimpong, Y. Jiao, J. W. Jones, S. Karpanty, and J. A. Parkhurst

**Assistant Professors:** L. Castello

**Adjunct Professors:** B. Czech, P. Grobler, M. Joos Vandewalle, D. Hawley, T. J. Newcomb, E. Smith, M. Schwarz, J. Walters, and Y. Palti

**Career Advisors:** *Fisheries Undergraduate* - B. R. Murphy (231-6959), *Wildlife Undergraduate* - C. Haas (231-9269), and *Graduate* - S. McMullin (231-8847)

Web: [www.fishwild.vt.edu](http://www.fishwild.vt.edu)

### Fish Conservation

The Fish Conservation program is for students interested in research and management of aquatic animals and ecosystems, including wild fish and shellfish, endangered species, and hatchery-raised fish. Most graduates work for state or federal fisheries agencies, environmental consulting firms, or public utilities. Because the more challenging and rewarding jobs require a master's degree, the program emphasizes preparation for graduate study.

### Wildlife Conservation

The Wildlife Conservation program is for students interested in research and management of terrestrial animals and ecosystems, including game birds and mammals, non-game animals, and endangered species. Most graduates work for state or federal wildlife agencies, environmental consulting firms, or private land management companies. Because the more challenging and rewarding jobs require a master's degree, the program emphasizes preparation for graduate study.

## Undergraduate Course Descriptions (FIW)

### 2114: PRINCIPLES OF FISHERIES AND WILDLIFE MANAGEMENT

Basic principles guiding the management of fish and terrestrial animals in wild habitats. Management of organisms, habitats, and human users examined in terms of biological, chemical/physical, ecological, and sociological theories and practices. Worldwide illustration from both recreational and commercial resources. Pre: BIOL 1006 or BIOL 1106.

(3H,3C)

### 2314: WILDLIFE BIOLOGY

Summary of biological characteristics of wild birds and mammals, especially relating to management by humans. Physiological, functional, structural, and behavioral adaptations of individuals to their environments and foods. Pre: (BIOL 2504 or BIOL 2704), FIW 2114.

(3H,3C)

### 2324: WILDLIFE FIELD BIOLOGY

Systematics, identification, and natural history of common native vertebrates and plants. Exposure to habitats/ecosystems of western Virginia. Observation, collection, and reporting of field data. Self-scheduled field and media lab activities required. Pre: BIOL 1106.

(1H,6L,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3414: DISEASE ECOLOGY AND ECOSYSTEM HEALTH

Principles of disease ecology with practical application of concepts using both human and wildlife disease examples. Importance of emerging infectious disease in conservation planning, public health and wildlife management. Pre: BIOL 1105, BIOL 1106.

(3H,3C)

### 3514: FISHERIES TECHNIQUES

Application of field and laboratory methods in fisheries management and research. Experience with fisheries equipment and techniques. Pre: 2114.

(1H,6L,3C)

### 3954: STUDY ABROAD

Variable credit course.

### 3964: INTERNSHIP THROUGH DIRECTED FIELD STUDY

Variable credit course.

### 4214: WILDLIFE FIELD TECHNIQUES

Field research methods for wild vertebrates in terrestrial environments. Application of research methodology including animal capture and marking, determination of sex, age, and condition, radio telemetry and map/compass/GPS orienteering, non-invasive methods of capture, habitat selection, and supervised group research projects. Pre: 4414, STAT 3615.

(2H,3L,3C)

### 4314: CONSERVATION OF BIOLOGICAL DIVERSITY

Principles and practices of conserving biological diversity. Causes, consequences and rates of extinction. Application of philosophical, biological, sociological and legal principles to the conservation of genes, plant and animal species and ecosystems. Pre: 4414, 4434.  
(3H,3L,4C)

#### 4324 (FOR 4324): GENETICS OF NATURAL AND MANGAGED POPULATIONS

Introductory genetics with an emphasis on evolutionary processes relevant to natural and managed populations of both plant and animal species. Traditional and modern genetics, including quantitative and population genetics, molecular evolution, genomics, and biotechnology. Pre: BIOL 1105, BIOL 1106, (STAT 3005 or STAT 3615 or FOR 3214).  
(3H,3C)

#### 4334: MAMMALOLOGY

Biology of mammals, including evolution, systematics, anatomy, physiology, ecology, and conservation challenges. Laboratory focus on identification, morphology, and zoogeography. Pre: BIOL 2704.  
(3H,3L,4C)

#### 4344: HERPETOLOGY

Biology of amphibians and reptiles, including evolution, systematics, anatomy, physiology, ecology, and conservation challenges. Laboratory focus on identification, morphology, and zoogeography. Pre: BIOL 2704.  
(3H,3L,4C)

#### 4414: POPULATION DYNAMICS AND ESTIMATION

Population growth, structure, and regulation of fish and wildlife populations including harvested populations, non-harvested populations, and small or declining populations. Methods of estimating demographic parameters such as population size, survival, and recruitment. Population viability analysis and genetic considerations in population dynamics. Pre: 2324.  
(3H,3C)

#### 4424: ICHTHYOLOGY

Morphology and physiology, systematics, zoogeography, and identification of fishes. Pre: BIOL 2504 or BIOL 2704.  
(2H,6L,4C)

#### 4434: WILDLIFE HABITAT ECOLOGY AND MANAGEMENT

Relationship of wildlife species to their habitats. Factors influencing distribution and abundance of wildlife populations. Vegetation succession and structure, habitat classification, modeling wildlife habitat relationships and management of habitats in forests, agricultural lands, rangelands, riparian/wetland and urban areas. Pre: 2114.  
(3H,3C)

#### 4454: 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 humans and domestic animals. Senior standing required.  
(3H,3C)

#### 4464: HUMAN DIMENSIONS OF FISHERIES AND WILDLIFE

Values, attitudes, and opinions of people toward 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. Senior standing required. Pre: 2114.  
(3H,3C)

#### 4474: WILDLIFE HABITAT EVALUATION

Application of methods for habitat evaluation through a group project to develop a habitat management plan. Students apply methods used to quantify habitat quality and assess impacts of various management actions. Emphasis is on Habitat Suitability Index models and the Habitat Evaluation

Procedures approach of the US Fish and Wildlife Service. Pre: 4214, FOR 3365, STAT 3005. Co: 4434.  
(3L,1C)

#### 4484 (BIOL 4484) (ENT 4484): FRESHWATER BIOMONITORING

Concepts and practices of using macroinvertebrates and fish to monitor the environmental health of freshwater ecosystems. Effects of different types of pollution and environmental stress on assemblages of organisms and underlying ecological principles. Role of biological studies in environmental regulation. Study design, field and laboratory methods, data analysis and interpretation, verbal and written presentation of results. Pre: (BIOL 2804), (BIOL 4354 or BIOL 4004 or ENT 4354 or FIW 4424 or FIW 4614).

(3H,3L,4C)

#### 4534: ECOLOGY AND MANAGEMENT OF WETLAND SYSTEMS

Introduction to the variety of wetland systems found in North America, though emphasis will focus 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. Objectives of and management techniques used to protect and/or manipulate wetland systems for wildlife and other human needs. Enrollment restricted to junior, seniors and graduate students. Pre: BIOL 3204.

(2H,3L,3C)

#### 4614: FISH ECOLOGY

Interactions of fish with the physical and biological environment. Adaptations of organisms, populations, and communities. Impacts of human activities on major aquatic ecosystems and important fishes.

Ecological principles for management of important sport, commercial, and prey fishes. Pre: BIOL 1006.

(3H,3C)

#### 4624: MARINE ECOLOGY

Marine organism, biological, ecological, chemical and physical processes of marine ecosystems in open sea, coastal and benthic environments, research methods and models in marine ecosystem simulation; fisheries in a dynamic ecosystem: human interference and conservation. Pre: BIOL 2804 or GEOS 3034.

(3H,3C)

#### 4714: FISHERIES MANAGEMENT

History, theory, and practice of fisheries management. Emphasis on basic strategies used in effective management and setting management objectives. Synthesis of fish population dynamics and manipulation, habitat improvement, and human management to achieve objectives. Case studies of major fisheries. Pre: 3514.

(3H,3L,4C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Foreign Languages and Literatures

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**Chair and Alumni Distinguished Professor:** Jacqueline Bixler

**Professors:** J.E. Bixler, D. Stoudt, R.J. Watson (Associate Chair), P.A. Mellen (Emeritus), J.L. Shrum (Emerita), and J.C. Ulloa (Emeritus)

**Associate Professors:** E. Austin, E. Bauer, A.S. Becker, M. Coburn, R. Efird, J.A. Folkart,

A. Gudmestad, M. GuÃye, S.P. Johnson, N. Milman-Miller, C. Noirot, M. Panford, R.L. Shryock, S. Sierra, F.G. Teulon, V. Venkatesh, and S.W. Farquhar (Emerita)

**Assistant Professors:** C. Andrango-Walker, M.C. CaÃa-JimÃnez, A. Dickow, S. Hofer, Y. Minkova, R. Phillips, and N. Sinno

**Instructors:** A. Azzam, A. Dalton, O. Guo, E. Hallerman, M. Hatzios, A. Hesp, Y. Kumazawa, J. M. Layne, N. LÃpez, Y. T. McKagen, S. Mishra, X. Moore, R. Nassereddine, J. Orr, K. Rutsala, A. Sobrado, M. Sguerri, C. Steer, G. Vargas, M. White, and Y. Younos

Web: [www.fll.vt.edu](http://www.fll.vt.edu)

## Overview

The study of foreign languages and literatures opens doors to international understanding and the appreciation of ancient and contemporary foreign civilizations. The department gives interested students of the university the following opportunities:

- To major or minor in a language;
- To prepare for careers in international organizations, the Foreign Service, government, business or industry, teaching;
- To prepare for a study abroad program;
- To obtain humanities credits on an elective basis;
- To fulfill undergraduate language requirements;
- To become a more aware and informed citizen of the world.

Majors and minors are offered in Classical Studies, French, German, Russian, and Spanish. Additional minors are offered in Arabic, Chinese Studies, Classical Languages, French for Business, Italian, Japanese Studies, and Latin. The department also offers instruction in modern Greek, Hebrew, and Portuguese.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

A minimum grade of C (2.0) must be earned by foreign language majors and minors in all courses required for the major or minor.

## Arabic

### Arabic Minor

To obtain a minor in Arabic, a student must complete 18 hours in Arabic at the 2000 level and above, including 2774, 3105, 3106, and 3304.

## Classical Studies

### Classical Studies Major

To complete the interdisciplinary major in Classical Studies, a student must complete 36 hours: 18 in Classical Studies (Humanities, History, Art & Art History, Mythology, Literature, Culture, Religion, etc.) and 18 hours in Classical Languages (Ancient Greek and/or Latin).

### Classical Studies Minor

To obtain an interdisciplinary minor in Classical Studies, a student must complete 18 hours in Classical Studies.

### Classical Languages Minor

To obtain a minor in Classical Languages, a student must complete 18 hours in Classical Languages (Ancient Greek and/or Latin). Variable-content courses may be repeated for credit.

## French

### French Major

To complete a major in French, a student must complete 33 hours at the 3000-level and above, including:

- 3105, 3106, \*3126, \*\*3304, 3314, and 4154;
- three of the following: 3164, 3205, 3206, 3305, 3306;
- two of the following: \*\*\*4314, 4324.

\*Students who demonstrate satisfactory oral proficiency by examination may be exempted from French 3126, in which case the three credits earned by examination can count toward the 33 credits required for the major. Students not placing into or out of 3126 are strongly advised to take 3125, which is an elective designed to enable students to achieve the level of oral proficiency required for entry into 3126.

\*\* Although 3304 is a prerequisite for 3305, 3306 and 3314, it may be waived in some instances. Contact the French program director for details.

\*\*\*French 4314 and 4324 are variable content courses that may be repeated for credit.

Except with consent in special cases, 2964: Field Study, 2984: Special Study, 4964: Field Study, 4974: Independent Study, 4984: Special Study, and 4994: Undergraduate Research may not be used to complete the major.

### French Minor

To obtain a minor in French, a student must complete 18 hours in French at the 2000-level and above, 12 of which must be taken at the advanced level, including 3105 and 3106. Students must take at least one 3000-level French culture and civilization course and one 3000-level French literature course. French 3314 can count either as a culture and civilization course or as a literature course. In some instances, French 3164 may count toward the minor.

### French for Business Concentration

To obtain the French for Business concentration, a student must complete 18 hours at the 1000-2000 level, including the following courses: 1105, 1106, 2105, 2164, 2714, and a CLE Area 7 course or any Study Abroad credit course.

## French for Business Minor

The French for Business minor requires 21 hours of French at the 2000-level and above. The minor must include the following courses: 2105, 2164, 3105, 3106, 3164, and one of the following: 2714, 3205, 3206 and one area 7 course.

## Advanced French for Business Minor

The Advanced French for Business minor requires 18 hours at the 3000 and 4000 levels. The minor must include 3105, 3106, 3164, 3304, 4164, and one of the following: 3205, 3206, 3314.

## German

### German Major

To complete a major in German, a student must complete 30 hours at the 3000-level and above, including the following required courses: 3105, 3106, \*3126, 3204, 3305, 3306, 4154, and six additional hours of 4000-level coursework. Major elective credit for courses taught in English may be awarded for up to two courses with the approval of the adviser.

\*Students may be exempted from German 3126 through demonstration of satisfactory oral proficiency by examination, in which case three additional hours of advanced elective course work in German will be necessary to complete the required 30 hours. Students not placing into or out of 3126 are strongly advised to take 3125, which is designed to enable students to achieve the level of oral proficiency required for entry into 3126; for most students, the hours represented by 3125 will be in addition to the minimum of 30 required for the major.

The 30 hours must be in German courses exclusive of 3125, 3195, 3196, 3414, and 4964

### German Minor

To obtain a minor in German, a student must complete 18 hours in German at the 2000-level and above, 12 of which must be taken at the 3000 or 4000 level, including the required courses 3105 and 3106. Up to one of the following advanced level courses taught in English may count towards the German minor with the approval of the adviser: 3414, 3474, 4334.

## Italian

### Italian Minor

To obtain a minor in Italian, a student must complete 18 hours of course work in Italian at the 2000 level and above, 12 of which must be taken at the advanced level and must include 3105, 3106, 3305, and 3306.

## Latin

### Latin Minor

To obtain a minor in Latin, a student must complete 18 hours of course work in Latin, including 6 hours at the 3000 level or above. Variable-content courses may be repeated for credit.

## Russian

### Russian Major

To obtain a major in Russian, students must take 33 hours, including the following: 2105, 2106, 2734, 3105, 3106, 3124, 3304, 3314, 4204\*, and 4304\*.



\*Variable-content courses may be repeated for credit. At least one of these courses will need to be taken twice in order to meet the requirement that at least 24 of the required 33 hours be taught in Russian.

## Russian Minor

To obtain a minor in Russian, a student must complete 18 hours in Russian at the 2000-level and above, 12 of which must be taken at the advanced level, including 3105 and 3106.

## Spanish

### Spanish Major

To complete a major in Spanish, a student must complete 33 hours at the 3000-level and above, including:

- 3105, 3106, \*3126, 3304;
- five of the following: at least two from the group 3404, 3414, 3444, 3464, 3474, 3484; and at least one from the group 3494, 3514, 3524, 3534, 3544
- two 4xxx-level courses.

\* Students may earn credit by exam for Spanish 3126 through demonstrating satisfactory oral proficiency by examination. Students not placing into or out of 3126 are strongly advised to take 3125, which is designed to enable students to achieve the level of oral proficiency required for entry into 3126. For most students, the hours represented by 3125 will be in addition to the minimum of 33 required for the major.

Except with consent in special cases, the 33 hours must be in Spanish courses exclusive of: 2964, 2984, 4964, 4974, 4984, and 4994.

**Students must earn 33 SPAN credits regardless of initial course placement. If you have AP or IB Spanish credit, see your Spanish Advisor.**

### Spanish Minor

To obtain a minor in Spanish, a student must complete 18 hours at the 2000-level and above, 12 of which must be taken at the advanced level, including 3105, 3106, 3304, and one of the following: 3404, 3414, 3444, 3464, 3474, 3484, 3494, 3514, 3524, 3534, 3544.

Students must earn 18 SPAN credits regardless of initial course placement. If you have AP or IB Spanish credit, see your Spanish Advisor.

### Restrictions for all majors and minors

1000-level courses do not count for Majors or Minors in French, German, Russian or Spanish.

1000-level courses do count toward Majors and Minors in Classical Studies, Latin, and Classical Languages.

Questions about courses numbered 4964, 4974, 4984, and 4994 should be addressed to the director of the specific language program or the department chair.

No more than six hours of 4964 (Field Study) may be taken.

Courses designated 3195-3196 do not satisfy the foreign language requirement for the University or the College of Liberal Arts and Human Sciences.

Courses designated as 3954 (Study Abroad) may carry major credit only if the student is eligible to pursue courses above the second-year level; otherwise credits will be assigned at the first and second-year level as appropriate in each individual case.

## Independent Study

The minimum grade point averages required for independent study in the Department of Foreign Languages & Literature are a 3.3 in 3000- and 4000-level courses in the language of the independent study, a 2.5 overall average, and a 3.0 in all course work completed after the freshman year. Students wishing to enroll in courses designated 4974 (Independent Study) must receive permission from the instructor and the department chair during the term prior to enrollment. No more than eight hours of independent study and/or undergraduate research combined may be counted toward a degree.

## Study Abroad

The department encourages students to work and/or study abroad. Information relating to work and/or study abroad programs is available from the department office (331 Major Williams) and from the Global Education Office.

The department offers summer study abroad programs in France, Greece, Italy, Japan, Oman, Senegal, Russia, Spain (Madrid and the Camino de Santiago), Switzerland, and semester- or year-long exchange programs in Caen (France), Oviedo (Spain), and Quito (Ecuador).

Information related to work and/or study abroad programs not sponsored by the department is available from the Global Education office.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the Foreign Languages and Literatures degree.

Satisfactory progress requirements toward the B.A. in French, B.A. in German, B.A. in Russian, and B.A. in Spanish can be found on their major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Repeating Work Completed

Students who have studied a foreign language may not repeat work completed at another institution without advance permission of the instructor. For example, those who have studied four years of a language in high school cannot study that language at the elementary level for credit. Native speakers may not take language courses below the 3000 level in their native language.

## Undergraduate Course Descriptions (FL)

2964: FIELD STUDY  
Pass/Fail only. Variable credit course.

2974: INDEPENDENT STUDY  
Variable credit course.

2974H: INDEPENDENT STUDY  
Variable credit course.

2984: SPECIAL STUDY  
Variable credit course.

4964: FIELD STUDY  
Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (ARBC)

#### 1105-1106: ELEMENTARY ARABIC

Fundamentals of Arabic with emphasis on developing proficiency for communication through reading, writing, speaking, listening, and cultural competence. ARBC 1105 is for students with no prior knowledge of the language. (3H,3C)

#### 2105-2106: INTERMEDIATE ARABIC

2105: First course in the intermediate-level sequence in Arabic. Review of grammar with increasing emphasis on reading, writing, cultural competency, and oral communication. Pre: 1106 for 2105; 2105 for 2106. (3H,3C)

#### 2774: ARAB CULTURE AND CIVILIZATION

Provides students with an overview of Arab cultures and civilizations, with an emphasis on the modern Middle East. Familiarizes students with the geography, history, politics and sociology of the Arab world and identifies the cultural forces that shape current events in the region. Major themes include the impact of colonialism, war, religion, and gender relations in the Arab world. Taught in English. (3H,3C)

#### 2974: INDEPENDENT STUDY

Variable credit course. X-grade allowed.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3105-3106: ADVANCED ARABIC

3105: First course in the advanced-level sequence in Arabic. Practice in communication skills in Arabic both orally and in writing, including review of grammar, directed composition, and conversation, with an emphasis on pronunciation, cultural competency, and oral expressions. Not recommended for native speakers. 3106: Second course in the advanced-level sequence in Arabic. Reinforcement of oral proficiency, reading, grammar, and writing skills, allowing students to explore a broad range of texts of general and professional interest. Not recommended for native speakers. Pre: 2106 for 3105; 3105 for 3106. (3H,3C)

#### 3304: MODERN ARABIC LIT IN TANS

Provides students with an overview of the genres and themes of Arabic literature in the twentieth century and beyond. Familiarizes students with the socio-historical context necessary for thinking and writing critically about Arabic literature. Translated texts from the major literary genres explore topics including postcolonialism, resistance, war, romance, religion, feminism, and pop culture. Taught in English. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course. X-grade allowed.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

## Undergraduate Course Descriptions (CHN)

**1105-1106: ELEMENTARY CHINESE**

Fundamentals of the Chinese language with emphasis on developing proficiency in practical language use and cultural competency. 1105 is for students with no prior knowledge of the language; 1106 is for students who have completed 1105, or more than one year, but less than three years of high school Chinese. (3H,3C)

**2105-2106: INTERMEDIATE CHINESE**

Emphasizes comprehension of written and spoken Mandarin Chinese, communication in Chinese; study of some literature and culture of the Chinese people. 2105 is for students who have completed 1105 and 1106 or equivalent. 2106 is for students who have completed 2105 or equivalent. X-grade allowed. Pre: 1106. (3H,3C)

**2964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3105-3106: ADVANCED CHINESE**

3105: Practice in communication skills in Chinese both orally and in writing, including review of grammar, directed composition, and conversation, with an emphasis on pronunciation, cultural competency, and oral expressions. Not recommended for native speakers. 3106: Reinforcement of oral proficiency, reading, grammar, and writing skills, allowing students to explore a broad range of texts of general and professional interest. Not recommended for native speakers. Pre: 2106 for 3105; 3105 for 3106. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course. X-grade allowed.

**3984: SPECIAL STUDY**

Variable credit course.

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Variable credit course.

## Undergraduate Course Descriptions (CLA)

1134 (RLCL 1134): INTRODUCTORY HUMANITIES: THE ANCIENT MEDITERRANEAN WORLD  
Ancient Greek, Hellenistic, and Roman cultures through their embodiments in the arts, literature, history, philosophy, and religion. Emphasis on the interrelationships among the various forms of cultural expression, and material and intellectual encounters among diverse groups in the ancient Mediterranean world. (3H,3C)

2444 (ENGL 2444) (RLCL 2444): ANCIENT GREEK AND ROMAN MYTHOLOGY  
Survey of Ancient Greek and Roman mythology and modern interpretations. In English. No knowledge of Ancient Greek or Latin required. Not for credit toward a Latin Minor. (3H,3C)

2454 (ENGL 2454): ANCIENT GREEK AND LATIN LITERATURE IN ENGLISH TRANSLATION  
A variable content course devoted to the study of major works of Ancient Greek and Latin literature in English translation. May be repeated for credit with different content. In English. No knowledge of Ancient Greek or Latin required. Not for credit toward a Latin Minor. (3H,3C)

2964: FIELD STUDY  
Variable credit course.

2974: INDEPENDENT STUDY  
Variable credit course.

2984: SPECIAL STUDY  
Variable credit course.

3954: STUDY ABROAD  
Variable credit course.

3984: SPECIAL STUDY  
Variable credit course.

4964: FIELD STUDY  
Variable credit course.

4974: INDEPENDENT STUDY  
Variable credit course.

4974H: INDEPENDENT STUDY  
Variable credit course.

4984: SPECIAL STUDY  
Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Variable credit course.

## Undergraduate Course Descriptions (FR)

#### 1105-1106: ELEMENTARY FRENCH

Fundamentals of the French language with emphasis on grammar, reading, composition, and conversation. 1105 for students with no prior knowledge of the language; 1106 for students who have completed 1105 or less than three years in high school. X-grade allowed. (3H,3C) I,II,III,IV.

#### 2105-2106: INTERMEDIATE FRENCH

Emphasizes comprehension of written and spoken French, communication in French, literature, and culture of French-speaking world. X-grade allowed. Pre: 1106 for 2105; 2105 for 2106. (3H,3C) I,II.

#### 2164: INTERMEDIATE BUSINESS FRENCH

This course emphasizes all four language skills (reading, writing, speaking, and listening) by focusing on various facets of the world of business and technology. It also develops students' understanding of French institutions and business practices. Pre: 2105. (3H,3C) II.

#### 2714: INTRODUCTION TO FRENCH CULTURE AND CIVILIZATION

French culture and civilization from the Middle Ages to the present. Interdisciplinary approach to literature, film, art, architecture, and theatre in the context of French cultural history. In English. (3H,3C)

#### 2794H: INDEPENDENT STUDY

Variable credit course.

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3105,3106: GRAMMAR, COMPOSITION AND CONVERSATION

Progressive and comprehensive review of French syntax and morphology. Practice in written and oral expression in French on a variety of topics in French culture. Conducted in French. May be taken out of sequence. X-grade allowed. Pre: 2106. (3H,3C) I,II.

#### 3125-3126: FRENCH FOR ORAL PROFICIENCY

For acquisition of measured levels of proficiency in speaking and understanding spoken French. Content-based instruction in small groups. 3125: to achieve an oral proficiency rating comparable to "Intermediate-high" on the American Council on the Teaching of Foreign Languages Oral Proficiency Interview (ACTFL-OPI) or "S -1+" on the Foreign Service Institute (FSI) scale. 3126: to achieve an oral proficiency rating comparable to "Advanced" on the ACTFL-OPI or a "2" on the FSI scale. Admission by oral exam. Pass/Fail only. X-grade allowed. Pre: 3105, 3106. (3H,3C) I,II.

#### 3164: ADVANCED BUSINESS FRENCH

In this skills-based course, students learn to use appropriate French technical vocabulary for different business contexts, do translation, write professional correspondence, and read articles related to the worlds of business, economics, and finance. Cross-cultural differences regarding the work place are also a focus of the course. I Pre: 3105, 3106. (3H,3C)

#### 3205,3206: FRENCH CULTURE AND CIVILIZATION

3205: Patterns of French life and culture in the context of social, intellectual, and institutional changes from the Middle Ages to the French Revolution. 3206: From the French Revolution to the present with an introduction to other francophone parts of the world. Pre: (3105, 3106). (3H,3C) 3205: I,II; 3206:

#### 3304: INTRODUCTION TO FRENCH LITERATURE

Introduction to French literature through analysis and discussion of selected texts from different periods

and genres. Methods, terminology, and practice of literary analysis. Intensive writing component. X-grade allowed. Pre: 2106. (3H,3C) II.

#### 3305,3306: SURVEY OF FRENCH LITERATURE

Readings in French literature from the Middle Ages to the present to acquaint students with literary techniques and contexts. Pre: 3304, 3105, 3106. (3H,3C)

#### 3314: INTRODUCTION TO FRANCOPHONE STUDIES

Introduction to the literatures and cultures of French-speaking countries outside of France including North Africa, the Caribbean, Sub-Saharan Africa, and Quebec. Examination of thematic and cultural aspects of literatures of these regions within their socio-historical contexts; explorations of such notions as postcolonialism, identity, race, and nation as they relate to the legacy of colonial France. Pre: 3105, 3106, 3304. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4154: ADVANCED COMPOSITION AND STYLISTICS

Intensive work in written French. Development of the student's ability to write clear, correct, and articulate French in a variety of modes (e.g., epistolary style, the formal and informal essay). Writing intensive. Pre: 3106. (3H,3C)

#### 4164: SPECIAL TOPICS IN BUSINESS FRENCH

A variable content course devoted to developing and perfecting highly advanced language skills through the study of special topics in the French and francophone business worlds. Emphasis on a mastery of specialized French for professional settings. May be repeated for credit with different content. Taught even years. Pre: 3106, 3164. (3H,3C) II.

#### 4314: STUDIES IN FRENCH LITERATURE

In-depth study of a selected topic in French literature, such as an author, a group of authors, a literary movement or genre during a specific period of French literary history (i.e., Voltaire, the Pleiade, Romanticism, the nouveau roman). May be repeated for credit with different content. Pre: (3105, 3106), (3305, 3306) or (3305, 3314) or (3306, 3314). (3H,3C) I,II.

#### 4324: SPECIAL TOPICS IN FRENCH LIFE, LITERATURE AND LANGUAGE

In-depth study of a selected topic in French culture or language as manifested in creative and historical literature, music, art, film, etc., such as phonetics, translation techniques, or the staging of dramatic works in French. May be repeated for credit with different content. Pre: (3105, 3106) or (3205, 3206). (3H,3C) I,II.

#### 4794: SENIOR TUTORIAL IN FRENCH STUDIES

Individual or small group sessions which give the student the opportunity to hone special language skills, with a focus on post-graduation application of these skills. May concentrate on areas such as technical or business language, linguistics, translation, interpreting, creative writing, specialized literary, or cultural studies. May be taken twice for credit with different content. Must be pre-arranged three weeks before end of previous semester. One 4000 level French course, senior standing, French major, and consent of French Section required. (1H,1C) I, II.

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course. X-grade allowed.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.

## Undergraduate Course Descriptions (GER)

**1105-1106: ELEMENTARY GERMAN**

Fundamentals of the German language with emphasis on grammar, reading, composition, and conversation. 1105: for students with no prior knowledge of the language; 1106: for students who have completed 1105 or less than three years in high school. (3H,3C) I,II.

**1114: ACCELERATED ELEMENTARY GERMAN**

Proficiency-oriented approach to elementary German, designed for learners who wish to progress rapidly through the beginning stages of language learning. It develops the four language skills (speaking, listening, reading, writing) in a cultural context. Partially duplicates GER 1105 and 1106. (6H,6C)

**2105-2106: INTERMEDIATE GERMAN**

Review of grammar with increasing emphasis on reading, writing, and oral communication. Pre: 1106. (3H,3C) I,II.

**2114: ACCELERATED INTERMEDIATE GERMAN**

Proficiency-oriented approach to intermediate German, designed for learners who wish to progress rapidly through the intermediate stages of language learning. The course strengthens the four language skills (speaking, listening, reading and writing) in a cultural context. Accelerated version of GER 2105-2106. Pre: 1106. (6H,6C)

**2724: INTRODUCTION TO GERMAN CULTURE AND CIVILIZATION**

German culture and civilization from the earliest period to the present. Interdisciplinary approach to literature, film, art, architecture, music, and theatre in the context of German cultural history. In English. (3H,3C)

**2964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3105-3106: GRAMMAR, COMPOSITION AND CONVERSATION**

Progressive and comprehensive review of German syntax and morphology. Practice in written and oral expression in German on a variety of topics in German culture. 3106 Writing intensive. Pre: 2106 or 2114 for 3105; 2106 for 3106. (3H,3C) I,II.

**3125-3126: GERMAN ORAL PROFICIENCY**

For acquisition of measured levels of proficiency in speaking and understanding spoken German. Content-based instruction in small groups. 3125: to achieve an oral proficiency rating comparable to "Intermediate-high" on the American Council on the Teaching of Foreign Languages Oral Proficiency Interview (ACTFL-OPI) or "S-1+" on the Foreign Service Institute (FSI) scale. 3126: to achieve an oral



proficiency rating comparable to "Advanced" on the (ACTFL-OPI) or a "2" on the FSI scale. Admission by oral exam. Taught alternate years. Pass/Fail only. (3H,3C) I,II.

#### 3204: CULTURE OF THE GERMAN-SPEAKING COUNTRIES

Study of German, Austrian, and Swiss culture and civilization from the Middle Ages to the present, including literature, art, architecture, film, and music. Pre: 3104 or 3105 or 3106. (3H,3C)

#### 3305-3306: SURVEY OF GERMAN LITERATURE

3305: Readings in major works of German literature from the late Middle Ages to the end of Classicism.

3306: Readings in major works of German literature from Romanticism to the end of World War II. Pre: (3105, 3106) or (3105, 3204) or (3105, 3306) or (3106, 3204) or (3106, 3306) for 3305; 3105 or 3106 for 3306. (3H,3C) I,II.

#### 3414 (ENGL 3414): GERMAN LITERATURE IN ENGLISH

A variable content course devoted to the study of major German literary works in English translation. May be repeated with different content. May not be taken for credit toward a major or minor in a foreign language. No knowledge of German required. In English. One 2000-level English literature course required. (3H,3C)

#### 3474: TOPICS IN GERMAN CINEMA

This course introduces students to critical issues in the history of German Cinema. It examines the aesthetic characteristics of each major period, with an emphasis on cinematic trends and the way in which film reflects cultural developments in German-speaking countries. The specific thematic content is variable. The course is taught in English. It may be taken twice for credit with different content. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4154: ADVANCED COMPOSITION AND STYLISTICS

Intensive advanced work in written German. Development of the student's ability to write clear, correct, and articulate German in a variety of modes. Style analysis. Writing intensive. Pre: 3106. (3H,3C)

#### 4304: AGE OF GOETHE

Major writers of the age of Goethe: Goethe, and Schiller; the development of German Classicism. Pre: 3106, 3306. (3H,3C)

#### 4314: STUDIES IN 19TH-CENTURY LITERATURE

Variable content course devoted to the study of 19th century drama, lyric, and prose. May be repeated for credit with different content. Pre: 3106, 3306. (3H,3C)

#### 4324: STUDIES IN 20TH-CENTURY LITERATURE

A variable content course devoted to the study of major literary works of the 20th century. May be repeated for credit with different content. Pre: 3106, 3306. (3H,3C)

#### 4334: SPECIAL TOPICS IN GERMAN LIFE, LITERATURE, AND LANGUAGE

Variable content course devoted to the study of various aspects of German culture, literature, and language. May be repeated for credit with different content. Pre: (3105 or 3106), (3305 or 3306). (3H,3C)

#### 4794: SENIOR TUTORIAL IN GERMAN STUDIES

Individual or small group sessions which give the student the opportunity to hone special language skills, with a focus on post-graduation application of these skills. May concentrate on areas such as technical or business language, linguistics, translation, interpreting, creative writing, specialized literary, or cultural studies. Must be pre-arranged three weeks before end of previous semester. May be taken twice for credit with different content. PRE: one 4000-level German course, major with senior standing, and consent required. (1H,1C) I,II.

4964: FIELD STUDY  
Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY  
Variable credit course.

4974H: INDEPENDENT STUDY  
Variable credit course.

4984: SPECIAL STUDY  
Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Variable credit course.

## Undergraduate Course Descriptions (GR)

1105-1106: CLASSICAL AND NEW TESTAMENT GREEK  
Introduction to classical/New Testament Greek, for development of reading ability. 1105: Short readings of graded difficulty. 1106: Introduction to the basics of the introduction of language, continued, with the introduction of select longer passages from ancient Greek authors. I,II (3H,3C)

1205-1206: ELEMENTARY MODERN GREEK  
Fundamentals of modern Greek with emphasis on developing proficiency for communication through reading, writing, speaking, listening, and cultural competence. GR 1205 is for students with no prior knowledge of the language. (3H,3C)

2104 (RLCL 2104): GREEK NEW TESTAMENT  
Review and refinement of the language is combined with readings from the New Testament in ancient Greek, with attention to historical context and analysis of the language May be repeated with different content for a maximum of 9 credits. Pre: 1106. (3H,3C)

2114: READINGS IN CLASSICAL GREEK LITERATURE  
Study of several major writers of ancient Greek literature. Selections from epic poetry, tragedies, philosophical dialogues, history and oratory. May be repeated with different content for a maximum of 9 credits. Pre: 1106. (3H,3C)

2964: FIELD STUDY  
Pass/Fail only. Variable credit course.

2974: INDEPENDENT STUDY  
Variable credit course.

2974H: INDEPENDENT STUDY  
Variable credit course.

2984: SPECIAL STUDY  
Variable credit course.

4964: FIELD STUDY  
Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY  
Variable credit course.

4974H: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (HEB)

1104 (JUD 1104): INTRODUCTION TO HEBREW LANGUAGE, CIVILIZATION AND CULTURE

Fundamentals of Modern Hebrew language with emphasis on grammar, reading, composition, and conversation. For students with no prior knowledge of the language. (3H,3C)

1114 (JUD 1114): ACCELERATED ELEMENTARY HEBREW LANGUAGE

Complementary introduction to the fundamentals of Modern Hebrew language with continued emphasis on grammar, reading, composition, and conversation. This course is for students who have completed 1104 or with permission of the instructor. 1114 is a four-credit course with a self-instruction component that demands student time outside of the class. (3H,2L,4C)

2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.

## Undergraduate Course Descriptions (ITAL)

1105-1106: ELEMENTARY ITALIAN

Fundamentals of the Italian language with emphasis on grammar, reading, composition, and conversation. 1105: for students with no prior knowledge of the language; 1106: for students who have completed 1105 or less than three years in high school. (3H,3C) I,II.

1114: ACCELERATED ELEMENTARY ITALIAN

Proficiency-oriented approach to elementary Italian, designed for learners who wish to progress rapidly through the beginning stages of language learning. Develops the four language skills (speaking, listening, reading, writing) in a cultural context. Duplicates 1105 and 1106. (6H,6C)

1204: ITALIAN LANGUAGE AND CULTURES

Fundamentals of the Italian Language with emphasis on developing proficiency in practical language use and cultural competency. Offered off campus. Does not fulfill the University foreign language requirement. Variable credit course. Variable credit course.

2105-2106: INTERMEDIATE ITALIAN

Emphasizes comprehension of written and spoken Italian, communication in Italian, literature, and culture of Italy. Pre: 1106. (3H,3C) I,II.

2964: FIELD STUDY

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Honors section. Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3105,3106: CULTURE COMPOSITION AND CONVERSATION**

Practice in oral and written communication in Italian on a variety of topics in Italian culture. Progressive and comprehensive review of Italian grammar. Expansion of vocabulary. Pre: 2106. (3H,3C)

**3305,3306: INTRODUCTION TO ITALIAN LITERATURE IN CONTEXT**

Overview of genres and themes of Italian literature from national unification to the present. Familiarizes students with the socio-historical context necessary to discuss and write critically about this literature. ITAL 3305 examines the period from unification until the end of World War II; ITAL 3306 examines the period from the end of World War II to the present. Taught in Italian. Pre: 3105 or 3106. (3H,3C)

**3474: TOPICS IN ITALIAN CINEMA**

Study of critical issues in the history of Italian Cinema, with an emphasis on different cinematic trends and aesthetic characteristics. Familiarizes students with the cultural, intellectual, and historical contexts of Italian cinematic works. Major themes include the Mafia, political terrorism, Italian genre cinema, and neorealism. Taught in English. Variable content. May be taken twice for credit with a different content. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course. X-grade allowed.

**3984: SPECIAL STUDY**

Variable credit course.

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Honors section. Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Honors section. Variable credit course.

## Undergraduate Course Descriptions (JPN)

**1105-1106: ELEMENTARY JAPANESE**

Fundamentals of the Japanese language with emphasis on developing proficiency in practical language use and cultural competency. 1105 is for students with no prior knowledge of the language; 1106 is for students who have completed 1105, or more than one year, but less than three years of high school Japanese. (3H,3C)

#### 2105-2106: INTERMEDIATE JAPANESE

Emphasizes comprehension of written and spoken Japanese, communication in Japanese; study of some literature and culture of the Japanese people. 2105 is for students who have completed 1105 and 1106 or equivalent. 2106 is for students who have completed 2105 or equivalent. X-grade allowed. Pre: 1106. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course. I,II,III,IV,V.

#### 3105-3106: ADVANCED JAPANESE

3105: Practice in communication skills in Japanese both orally and writing, including review of grammar, directed composition and conversation, with an emphasis on pronunciation, cultural competency, and oral expressions. Not recommended for native speakers. 3106: Reinforcement of oral proficiency, reading, grammar, and writing skills, allowing students to explore a broad range of texts of general and professional interest. Not recommended for native speakers. Pre: 2106 for 3105; 3105 for 3106. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (LAT)

#### 1105-1106: ELEMENTARY LATIN

Introduction to Latin, for development of reading ability. 1105: Introduction to the basics of the language and short readings of graded difficulty. 1106: Introduction to the basics of the language, continued, with introduction of selected passages from ancient Roman authors for reading, comprehension, and translation. (3H,3C) I,II.

#### 2104: CICERO AND LIVY

A course in two major Latin prose authors. Review and refinement of the language is combined with an

increasing attention to historical, cultural, linguistic and literary questions. May be repeated with different content for a maximum of 9 credits. Pre: 1106. (3H,3C)

2114: LATIN EPIC: VERGIL AND OVID

A course in two important Latin poets of the Age of Augustus with a view to increasing the students ability to understand and read Latin. Review and refinement of the language is combined with an increasing attention to historical, linguistic, cultural, and literary questions. May be repeated with different content for a maximum of 9 credits. Pre: 1106. (3H,3C)

2124: LATIN LYRIC: CATULLUS AND HORACE

Two important Latin poets of the Late Republic. Review and refinement of the language is combined with an increasing attention to historical, linguistic, cultural, and literary questions. May be repeated with different content for a maximum of 9 credits. Pre: 1105, 1106. (3H,3C)

2134: LATE MEDIEVAL LATIN

Post-classical Latin, from Augustine and Boethius through the Middle Ages, Renaissance, and the Modern Age. Review and refinement of the language is combined with an increasing attention to historical, cultural, linguistic and literary questions. May be repeated with different content for a maximum of 9 credits. Pre: 1105, 1106. (3H,3C)

2964: FIELD STUDY

Pass/Fail only. Variable credit course.

2974: INDEPENDENT STUDY

Variable credit course.

2974H: INDEPENDENT STUDY

Honors section.

Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

3004: READINGS IN LATIN LITERATURE

A variable content course devoted to the study of major Latin texts not offered in the 2000-level courses. Emphasis is on content, style, and context. May be repeated for credit with different content. Two 2000-level courses in Latin or equivalent proficiency required. Writing Intensive. (3H,3C)

4004: DIRECTED STUDIES IN LATIN PROSE COMPOSITION

Application of Latin grammar structure to the translation of English into Latin. Original compositions are written in Latin. (Will be offered during the academic year whenever there is sufficient enrollment and available staffing). One 3000-level course in Latin required. (3H,3C)

4964: FIELD STUDY

Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.

## Undergraduate Course Descriptions (PORT)

### 1105-1106: BEGINNING CONVERSATIONAL PORTUGUESE

Essential vocabulary and structures of the Portuguese language as spoken in Brazil; emphasis on active spoken and written use of the language for practical daily purposes. (3H,3C)

### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

### 4974: INDEPENDENT STUDY

Variable credit course.

### 4984: SPECIAL STUDY

Variable credit course.

### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (RUS)

### 1105-1106: ELEMENTARY RUSSIAN

Fundamentals of grammar, pronunciation, conversation. 1105: Grammar and conversation; 1106: Grammar, conversation, and several selected readings from Russian literature. (4H,4C)

### 1114: ACCELERATED ELEMENTARY RUSSIAN

Proficiency-oriented approach to elementary Russian, designed for learners who wish to progress rapidly through the beginning stages of language learning. Develops the four language skills (speaking, listening, reading, writing) in a cultural context. Duplicates 1105 and 1106. (6H,6C)

### 2105-2106: INTERMEDIATE RUSSIAN

Grammar, reading, conversation, and composition. Emphasizes comprehension of written and spoken Russian. Pre: 1106. (3H,3C)

### 2114: ACCELERATED INTERMEDIATE RUSSIAN

Proficiency-oriented approach to intermediate Russian for learners who wish to progress rapidly through the intermediate stages of language learning. Develops the four language skills (speaking, listening, reading, writing) in a cultural context. Duplicates 2105 and 2106. Pre: 1106 or 1114. (6H,6C)

### 2734: INTRODUCTION TO RUSSIAN CULTURE AND CIVILIZATION

Russian culture and civilization from the Middle Ages to the present. Interdisciplinary approach to Russian literature, art, architecture, music, film, and theatre in the context of Russian cultural history. In English. (3H,3C)

### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

**2974H: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3105,3106: GRAMMAR, COMPOSITION AND CONVERSATION**

Detailed study of grammar. Practice in written and oral expression in Russian on a variety of topics. Supplementary readings to emphasize application of grammatical principles. 3105 includes a rapid grammatical review. Pre: 2106. (3H,3C)

**3124: RUSSIAN FOR ORAL PROFICIENCY**

Devoted to the acquisition of measured levels of proficiency in speaking and understanding spoken Russian. Content-based instruction in small groups. For students who would like to achieve an oral proficiency rating comparable to "Intermediate-high" on the American Council on the Teaching of Foreign Languages Oral Proficiency Interview (ACTFL-OPI) or "S-1+" on the Foreign Service Institute (FSI) scale. Admission by oral exam required. Taught alternate years. Pass/Fail only. (3H,3C)

**3304: SURVEY OF NINETEENTH-CENTURY RUSSIAN LITERATURE IN TRANSLATION**

Masterpieces of Russian fiction and poetry written between 1815 and 1881. Begins with the romantic poetry of the early nineteenth century and traces the beginnings of Russian prose from early short stories to the rise of the novel as the dominant literary form in the second half of the century. Topics range from history to politics to theological and philosophical issues examined in various works. Methods, terminology and practice of literary analysis. In English. Pre: ENGL 1106 or ENGL 1204H. (3H,3C)

**3314: SURVEY OF TWENTIETH-CENTURY RUSSIAN LITERATURE IN TRANSLATION**

Masterpieces of the twentieth-century Russian literature. Symbolist, Acmeist and Futurist poetry, modernist and postmodernist prose. Terminology, practice, and methods of literary analysis. Taught in English. Pre: ENGL 1106 or ENGL 1204H. (3H,3C)

**3424 (ENGL 3424): RUSSIAN LITERATURE IN ENGLISH**

Variable-content course devoted to the study of Russian literary classics. Readings and lectures in English. Topics will range from general surveys of 19th century or 20th century Russian literature to more intensive study of the works of a single major author like Tolstoy or Dostoevsky. May be repeated with different content. No knowledge of Russian required. In English. One 2000-level English literature course required. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course. X-grade allowed.

**3984: SPECIAL STUDY**

Variable credit course.

**4204: TOPICS IN RUSSIAN CULTURE AND CIVILIZATION**

Specific topics in Russian culture and civilization. Variable content. May be repeated for credit with different content. Pre: 3105. (3H,3C)

**4304: STUDIES IN RUSSIAN LITERATURE**

Selected masterpieces of Russian literature, read in original. Lectures and discussions in Russian. May be repeated for credit with different content. Pre: 3105. (3H,3C)

**4964: FIELD STUDY**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.



#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (SPAN)

#### 1105-1106: ELEMENTARY SPANISH

Fundamentals of grammar, composition, and oral skills. Readings carefully selected for comprehension and simple conversation. 1105 for students with no high school Spanish; 1106 for students who have completed 1105 or who have less than three years of high school Spanish. (3H,3C) I,II,III,IV.

#### 1114: ACCELERATED ELEMENTARY SPANISH

Condenses SPAN 1105 and 1106. Proficiency-oriented approach to elementary Spanish, designed for learners with some prior experience in the language or for those who wish to progress rapidly through the beginning stages of language learning. Supplemented with a self-instructional electronic component. Meets University and college foreign language requirement. SPAN 1114 duplicates SPAN 1106. (3H,2L,4C) I,II.

#### 2105-2106: INTERMEDIATE SPANISH

Review of grammar with increasing emphasis on reading, writing, and oral communication. X-grade allowed. Pre: 1106 or 1114 for 2105; 2105 for 2106. (3H,3C) I,II.

#### 2154 (HORT 2154): SPANISH FOR THE GREEN INDUSTRY

Dialogue-based language course focusing on the vocabulary and grammatical structures pertaining to Green and Agricultural Industry jobs. Includes vocabulary and context specific to jobs and workers in greenhouse, nursery, turf and landscape environments. Spanish culture is included throughout the course along with grammar and structure. Prior study in Spanish is helpful but not required. I, II. (3H,3C)

#### 2744: INTRODUCTION TO SPANISH CULTURE AND CIVILIZATION

Introduction to Spanish culture and civilization from the Middle Ages to the present. Interdisciplinary approach combining the study of literature, the arts, architecture, music, theatre, and film in the context of Spanish cultural history. In English. (3H,3C)

#### 2754: INTRODUCTION TO SPANISH-AMERICAN CULTURE AND CIVILIZATION

Spanish-American culture and civilization from the discovery of the New World to the present. Interdisciplinary approach to literature, film, art, architecture, music, and theatre in the context of Spanish-American cultural history. In English. (3H,3C)

#### 2764: INTRODUCTION TO LATINO AMERICAN STUDIES

Introduction to interdisciplinary field of Latino American Studies. Exploration of debates and problems of Latin American and Latina/o history and culture. Examination and analysis of transnational, social, and cultural trends. Emphasis on connections between United States and Latin America, and local and regional Latina/o communities. In English. (3H,3C)

#### 2774: MINORITY LANGUAGES IN THE SPANISH-SPEAKING CONTEXT

Examination of language policies and practices with regard to minority languages across the Spanish-speaking context, histories of minority languages in Spanish-speaking areas, and the current socio-political situations of these languages and their speakers; exploration of issues concerning linguistic rights, such as access to education, economic opportunities, and political status; analysis of the implications of restrictions on minority groups' linguistic rights; and discussion of why some minority-

language speakers have been more successful in their language conservation or revitalization efforts than others. In English. Does not count toward the Spanish major or minor (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3105-3106: GRAMMAR, COMPOSITION AND CONVERSATION

Practice in communication skills in Spanish both orally and in writing, including review of grammar, directed composition, and conversation, with an emphasis on pronunciation and oral expressions. Not recommended for native speakers of Spanish. Pre: 2106 for 3105; 3105 for 3106. (3H,3C) I,II.

#### 3125-3126: SPANISH FOR ORAL PROFICIENCY

For acquisition of measured levels of proficiency in speaking and understanding spoken Spanish. Content-based instruction in small groups. 3125: to achieve an oral proficiency rating comparable to "Intermediate-high" on the American Council on the Teaching of Foreign Languages Oral Proficiency Interview (ACTFL-OPI) or "S-1+" on the Foreign Service Institute (FSI) scale. 3126: to achieve an oral proficiency rating comparable to "Advanced" on the (ACTFL-OPI) or a "2" on the FSI scale. Admission by oral exam. Pass/Fail only. (3H,3C) I,II.

#### 3304: INTRODUCTION TO HISPANIC LITERATURE

Introduction to Hispanic literature through analysis and discussion of selected major texts from Spain and Spanish America. Methods, terminology, and practice of literary analysis. Course requirements may be satisfied by taking SPAN prerequisite prior to or concurrent with course. X-grade allowed. Pre: 3106. (3H,3C)

#### 3404: EARLY PENINSULAR CULTURE AND LITERATURE

This course examines Spain's construction of a cohesive national identity as it comes together to form a nation and to become a leading world empire. Exploring the development of Spain from pre-history to the end of the Golden Age in 1700, the class engages diverse literary and cultural texts in dialogue with the key historical and political events of their period in order to provide a greater appreciation of how various cultural media interact with one another in the construction of an overall national identity. Pre: 3304. (3H,3C)

#### 3414: MODERN PENINSULAR CULTURE AND LITERATURE

This course examines Spain's efforts to re-construct itself in the years following the waning of its imperial power. Exploring the development of Spanish identity from 1700 to the present, the class examines diverse literary and cultural texts within the historical, political, and social context in which they were created. The course treats canonical as well as non-canonical texts, from both "high" and "popular" culture, and includes narrative, poetry, theatre, film, art, and architecture. Pre: 3304. (3H,3C)

#### 3444: EARLY SPANISH-AMERICAN CULTURE AND LITERATURE

This course traces the cultural development of Spanish America from the pre-Hispanic era to independence from Spain in the 19th century. Key literary and cultural texts are examined within the historical, political, and social context in which they were created. The course includes historical texts, narrative, poetry, drama, art, architecture, and music. Pre: 3304. (3H,3C)

#### 3464: MODERN MEXICAN AND CENTRAL AMERICAN CULTURE AND LITERATURE

Exploration of the civilization, culture, and literature of Mexico and Central America, spanning the 19th century post-independence period to the present; examination of literary and cultural texts within the historical, political, and social context in which they were created; study of canonical as well as non-

canonical texts, from both "high" and "popular" culture, including historical texts, narrative, poetry, drama, film, art, architecture, and music. Taught in Spanish. Pre: 3304. (3H, 3C). Pre: 3304. (3H,3C)

#### 3474: MODERN SPANISH-CARIBBEAN CULTURE AND LITERATURE

Exploration of the civilization, culture, and literature of the Spanish Caribbean, spanning the 19th century post-independence period to the present; examination of literary and cultural texts within the historical, political, and social context in which they were created; study of canonical as well as non-canonical texts, from both "high" and "popular" culture, including historical texts, narrative, poetry, drama, film, art, architecture, and music. Taught in Spanish Pre: 3304. (3H,3C)

#### 3484: MODERN ANDEAN AND SOUTHERN CONE CULTURE AND LITERATURE

Exploration of the civilization, culture and literature of the Andean and Southern Cone regions of South America, spanning the 19th century post-independence period to the present; examination of literary and cultural texts with the historical, political, and social context in which they were created; study of canonical as well as non-canonical texts, from both "high" and "popular" culture, including historical texts, narrative, poetry, drama, film, art, architecture, and music. Taught in Spanish Pre: 3304. (3H,3C)

#### 3494: INTRODUCTION TO HISPANIC LINGUISTICS

Introduction to fundamental concepts of Hispanic linguistics; exploration of context-appropriate language use; examination of linguistic properties in Spanish (phonetics/phonology, morphology, syntax, and semantics/pragmatics); development of analytical tools necessary to explore the relationship between the Spanish language and Hispanic cultural practices; and application of knowledge of linguistics to hands-on activities. In Spanish. [Pre: 3304 (3H, 3C)] Pre: 3304. (3H,3C)

#### 3514: SPANISH FOR THE MEDICAL PROFESSIONS

Specialized course applying knowledge of the Spanish language and its culture to the medical professions. Contextualized use of specific vocabulary, idiomatic expressions, and cultural practices in real-world situations. Taught in Spanish. Pre: 3304. (3H,3C)

#### 3524: INTRODUCTION TO SPANISH TRANSLATION

Introduction to the translation of various types of texts, such as literature, business correspondence, commercial advertising, and legal documents. Includes translation from English to Spanish and from Spanish to English, as well as a thorough review of Spanish grammar and idiomatic language. Taught in Spanish. Pre: 3304. (3H,3C)

#### 3534: SPANISH FOR THE BUSINESS PROFESSIONS

Vocabulary, idiomatic expressions, business letters, and customs common to the Spanish-speaking commercial milieu. For students who would like to apply their language knowledge to careers in the business world. In Spanish. Pre: 3304. (3H,3C)

#### 3544: SPANISH PHONETICS AND PHONOLOGY

Provides students with an overview of phonetics and phonology in Spanish. Familiarizes students with the articulatory descriptions of vowels and consonants of Spanish and the transcription of Spanish speech using the International Phonetic Alphabet. Compares and contrasts the sound systems of Spanish and English. Provides students the tools to improve their pronunciation of Spanish. Explores the phonetic variation that exists throughout the Spanish speaking world taught in Spanish. Pre: 3304. (3H,3C)

#### 3554: TEACHING SPANISH

Examination of theories and approaches to second-language and heritage-language learning and teaching. Discussion of technological resources and authentic materials that promote language teaching and individual differences that affect language learning. Analysis of pedagogical materials for the Spanish-language classroom. Hands-on experience with lesson-plan design for teaching Spanish. Taught in Spanish. Pre: 3304. (3H,3C)

#### 3684: CROSSING THE BORDER: LIVING THE LITERATURE

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. Pre: 2106. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course. X-grade allowed.

**3984: SPECIAL STUDY**

Variable credit course.

**4104: ADVANCED GRAMMAR AND STYLE**

Analysis of and practice with advanced grammatical and stylistic concepts, including idiomatic and colloquial usage. Intended to help advanced students achieve high levels of proficiency in writing and speaking Spanish. X-grade allowed. Pre: 3106. (3H,3C) II.

**4114: TOPICS IN SPANISH LINGUISTICS**

Variable content course that surveys linguistic concepts and methods as related to the Spanish language. Topics may include the study of the phonology, morphology, syntax, and semantics of Spanish; the pedagogical application of these language systems; the psychological and social context of language; and the development of Spanish from its origins to its modern form. May be repeated for credit with different content. I Pre: 3494 or 3544. (3H,3C)

**4124: SPANISH TRANSLATION: THEORY AND TECHNIQUE**

Introduction to translation theories and application of these theories to different types of texts, including literature, business correspondence, commercial advertising, and legal documents. Includes translation from English to Spanish and from Spanish to English, as well as a thorough review of Spanish grammar and idiomatic language. Pre: 3524. (3H,3C)

**4304: STUDIES IN MEDIEVAL AND GOLDEN AGE LITERATURE**

A variable content course devoted to Hispanic literature of the Middle Ages and of the Golden Age. The texts selected are studied not only for their aesthetic value but also for their historical and cultural significance. May be taken twice for credit with different content. I Pre: 3404 or 3414 or 3444 or 3464 or 3474 or 3484. (3H,3C)

**4314: STUDIES IN 18TH AND 19TH CENTURY LITERATURE**

A variable content course devoted to Hispanic literature of the 18th and 19th centuries. The texts selected are studied not only for their aesthetic value but also in terms of their historical and cultural significance. May be taken twice for credit with different content. Taught alternate years. I Pre: 3414 or 3404 or 3444 or 3464 or 3474 or 3484. (3H,3C)

**4324: STUDIES IN 20TH AND 21ST CENTURY HISPANIC LITERATURE**

A variable content course devoted to Hispanic literature of the 20th and 21st centuries. Offers an in-depth literary exploration of a significant historical period, cultural movement, theme, or genre. Focuses on literary and cultural analysis from a variety of perspectives. Practices advanced Spanish oral and writing skills. Examines texts that have aesthetic value and historical and cultural significance. May be taken up to three times for credit with different content. Pre: (3404 or 3414) or (3444 or 3464 or 3474 or 3484). (3H,3C)

**4334: SPECIAL TOPICS IN HISPANIC LIFE, LITERATURE, AND LANGUAGE**

Broad central themes of Hispanic culture as manifested in creative and historical literature, music, art, film, etc., or in language, such as the history of the Spanish language, translation techniques, or the staging of dramatic works in Spanish. Historical and/or national boundaries are crossed whenever the nature of the topic permits. May be repeated for credit with different content. Taught alternate years. X-grade allowed. Pre: 3404 or 3414 or 3444 or 3464 or 3474 or 3484. (3H,3C) II.

**4344: HISPANIC LITERATURE AND THE REPRESENTATION OF HISTORY**

Focuses on the relationship between history and literature in the Hispanic world through an interdisciplinary lens. Examines different geographical regions of the Hispanic world, theoretical readings, and the ways that authors have used various literary styles to portray, re-write, subvert, and even contradict their countries' official history. Examines texts that have aesthetic value and historical and cultural significance. Practices advanced Spanish oral and writing skills. This variable topics course may

be repeated up to three times if topics are different. Pre: (3404 or 3414 or 3444 or 3464 or 3474) or 3484. (3H,3C)

#### 4794: SENIOR TUTORIAL IN SPANISH STUDIES

Individual or small group sessions which give the student the opportunity to hone special language skills, with a focus on post-graduation application of these skills. May concentrate on areas such as technical or business language, linguistics, translation, interpreting, creative writing, specialized literary, or cultural studies. May be taken twice for credit with different content. Must be pre-arranged three weeks before end of previous semester. One 4000 level Spanish course required. Restricted to Seniors. Restricted to Spanish majors. Consent of Spanish Section required. (1H,1C) I,II,III,IV.

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4964H: FIELD STUDY

Honors Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Forest Resources and Environmental Conservation

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[Environmental Informatics](#)

[Forest Resource Management](#)

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[Environmental Resource Management](#)

[Urban Forestry](#)

[Conservation and Recreation Management](#)

[Environmental Education and Natural Resources Science Education](#)

[Watershed Management](#)

[Water: Resources, Policy, and Management](#)

[Undergraduate Course Descriptions \(FREC\)](#)

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**University Distinguished Professor:** H. E. Burkhart

**Alumni Distinguished Professor:** J. R. Seiler

**Julian N. Cheatham Professor:** G. S. Amacher

**Honorable Garland Gray Professor:** T. R. Fox

**Professors:** W. M. Aust, R. B. Hull, S. P. Prisley, J. Sullivan, and R. H. Wynne

**Associate Professors:** M. C. Bolding, A. M. Brunner, C. A. Copenheaver, S. D. Day, J. A. Holliday, J. A. McGee, J. F. Munsell, P. J. Radtke, M. J. Stern, B. D. Strahm, V. A. Thomas, and P. E. Wiseman

**Assistant Professors:** S. M. Barrett, K. M. Cobourn, J. A. Holliday, D. L. McLaughlin, M. G. Sorice, and R.Q. Thomas

**Adjunct Faculty:** C. B. Anderson, S. W. Bailey, G. M. Busby, D. C. Chojnacky, J. W. Coulson, A. J. Finkral, J. D. Knoepp, W. A. Lakel, C. A. Maier, J. L. Marion, R. Rubilar, E. B. Schilling, D. J. Soucek, E. B. Sucre, J. A. Westfall, and James Westlake

**Courtesy Appointments:** J. R. Harris (Horticulture), P. A. Miller (Landscape Architecture), and S. M. Salom (Entomology)

Web: [www.frec.vt.edu](http://www.frec.vt.edu)

## Environmental Informatics

Environmental Informatics applies information science to the management of natural resources. It includes aspects of geographic information, mathematical and statistical modeling, remote sensing, database management, knowledge integration, and decision making.

## Forest Resource Management

The Forest Resource Management option emphasizes the biology, policy, and management skills needed to ensure the sustainability of the many renewable forest resources on which society depends. Graduates manage the forested landscape to provide society a renewable supply of wood and paper products along with clean water, recreation opportunity, wildlife habitat, and environmental quality.

## Forest Operations and Business

Forest Operations and Business graduates are well prepared for careers in private industry emphasizing harvesting and reforestation operations. Forest Operations and Business specializes beyond the Forest Resource Management option by emphasizing the operations side of forestry along with landowner assistance and management skills for people and business.

## Environmental Resource Management

The Environmental Resource Management option develops professionals who tackle a variety of environmental issues in the forested landscape. The foundation of this area of study is sustainability with additional emphasis placed on water resources, forest soils, environmental policy, and wildlife management.

## Urban Forestry

The Urban Forestry option produces graduates who can deal with the ecological and biological characteristics of the forest in an urban environment, as well as the managerial and political context within which forest management takes place. Special education, training, and experience are necessary to address the many and complex biological, social, economic, and political issues that are part of the urban forest setting.

## Conservation and Recreation Management

Conservation and Recreation Management blends natural sciences, resource management, and social sciences disciplines and topics. Graduates provide high quality recreation experiences to ever increasing numbers of recreationists while protecting the natural environment on which these experiences depend. Emphasis is on the human dimensions of natural resource management.

## Environmental Education (K-6) and Natural Resources Science Education (6-12)

Environmental Education prepares students to teach in elementary schools, while Natural Resources Science Education prepares students to teach Earth Science, Life Science or Agricultural Education at middle and high schools. Both options are intended as feeders into the Masters in Education at Virginia Tech, which provides necessary licensure. With proper planning, the Masters degree can be completed in one year.

# Watershed Management

The Watershed Management option will qualify students for hydrology positions with the USDA and the USGS.

## Water: Resources, Policy, and Management

The Water: Resources, Policy, and Management degree addresses the protection and development of water resources by providing the interdisciplinary training required to meet water challenges and opportunities now and in the future.

## Undergraduate Course Descriptions (FREC)

### 1004 (GEOG 1084): DIGITAL PLANET

Exploration of innovative geospatial technologies and their impact on the world around us, including how humans interact with the environment and each other. Roles of location-based services, global positioning systems, geographic information systems, remote sensing, virtual globes and web based mapping for environmental applications. Skills and techniques for spatial thinking and environmental decision-making. (3H,3C)

### 1044: INTRODUCTION TO ENVIRONMENTAL INFORMATICS

Application of information science to environmental management. Role of information science, mathematical and statistical modeling, geospatial technology, database management, knowledge integration, and decision science in environmental decision-making. Skills and techniques required to assist scientists and managers with the challenges of collecting, collating, archiving, modeling, analyzing, visualizing, and communicating information in support of natural resource management. (3H,3C)

### 2004: FOREST ECOSYSTEMS

Living and non-living components of forest ecosystems, including plants, soils, microbes, and the atmosphere. Water, energy, and nutrient cycles in forest ecosystems. Relationships between forest ecosystem structure and function. Changes in properties and processes of forest ecosystems over time and in response to human activities. Capacity and management of forest ecosystems to provide goods and services, including climate regulation, clean water, wildlife habitat, forest products, and recreation opportunities. (3H,3C)

### 2114: ECOLOGY OF APPALACHIAN FORESTS

Introduction to the natural history, tree biology, tree identification, forest ecology, management and forest types of the Appalachian region. Contemporary issues related to forest functions will be discussed including carbon storage, global warming, invasive forest species, wildlife management, fire, biofuels, agroforestry, urban forests, ecosystem restoration, clean water, recreation, and use of renewable resources. (3H,3C)

### 2124: FOREST, SOCIETY & CLIMATE

Role of forest ecosystems on the global carbon cycle, climate, biodiversity and economies. Anthropogenic impacts on forest ecosystems and their ecological function in the face of changing climate. Climate-related threats to global forests, including loss of biodiversity, deforestation, forest fires, and invasive species. Sustainable forest management for anticipated future scenarios. (3H,3C)

### 2134 (HORT 2134): PLANTS AND GREENSPACE IN AN URBAN COMMUNITY

Modern concepts of sustainability changing plant use in urban settings. Fundamentals of urban horticulture and urban ecosystems. Philosophy of sustainability, urban forestry, urban wildlife, sustainable and community-supported agriculture, and innovations merging plant and ecosystem functions with building and site engineering. Multi-disciplinary emphasis in individual, community, regional, and global scales. (3H,3C)

### 2214: INTRODUCTION TO LAND AND FIELD MEASUREMENTS

Measurement of land and field attributes including geographic position, land distance, direction, area,



slope, elevation and boundary attributes. Use and development of maps used in natural resource applications. Use of global positioning systems and geographic information systems in the acquisition and management of land and field measurements. Assessment of vegetation attributes with field plots. Use of computer software to manage and analyze data and present results. Pre: (MATH 1016 or MATH 1025). Co: 2324. (2H,3L,3C)

#### 2254 (HORT 2554): ARBORICULTURE FIELD SKILLS

Field observation, discussion, and practice of skills employed in the management of urban landscape trees. Hands-on experience with tree pruning, removal, pest control, fertilization, cabling/bracing, lightning protection, and climbing. Emphasis on arborist safety, professional ethics, and best management practices. Guest instruction provided in part by professionals working in the tree care industry. Pass/Fail only. (3L,1C)

#### 2314: FOREST BIOLOGY AND DENDROLOGY

Introduction to the botany, physiology, genetics and silvics of important forest trees of North America. Pre: BIOL 1006 or BIOL 1106. Co: 2324. (2H,2C)

#### 2324: DENDROLOGY LABORATORY

Field identification of trees of North America with particular emphasis on trees native to the Eastern United States. (3L,1C)

#### 2414: FIELD EXPERIENCE IN FOREST RESOURCES AND ENVIRONMENTAL CONSERVATION

Field exercises to develop skills needed to sustainably manage forest and environmental resources including navigation and mapping, inventory of timber and non-timber resources, soil and water conservation, forest and recreation management, forest operations and timber harvesting. (6L,2C)

#### 2514: WILDLAND FIRE: ECOLOGY AND MANAGEMENT

Provide students with basic knowledge on how: fire has an impact on forest environments; the environment and weather influence fire behavior; wildland fires are suppressed; and fire is used as a land and vegetation management tool. The course will also provide students with the knowledge and training to qualify as a basic wildland firefighter (FFT2-Red Card). Extended laboratory sessions will provide practice in fire behavior prediction, prescribed burning techniques, and fire control methodology. Pre: BIOL 1105 or BIOL 1106, CHEM 1035. (2H,3L,3C)

#### 2554 (LAR 2554): NATURE AND AMERICAN VALUES

Introduces students to the evolving relationship between nature and American society; emphasizing the ethics and values which underlie forest, park, and wildlife management. Students are introduced to contemporary land use issues and learn to articulate, defend, and critique the ethical positions surrounding these issues (i.e., wilderness, sustainability, biodiversity, hunting, old growth, suburban sprawl, environmental activism). (3H,3C)

#### 2784 (SBIO 2784): GLOBAL FOREST SUSTAINABILITY

A socio-economic approach to examining the management and use of the world's forests, enhance knowledge of global forest resources and products, and understand the roles and relationships of key stakeholders. (3H,3C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3104: PRINCIPLES OF WATERSHED HYDROLOGY

Study of hydrology in watersheds. Qualitative and quantitative principles of physical hydrological processes governing the movement, storage, and transformation of water on the Earth's surface as influenced by watershed characteristics, including human modifications. Pre: Junior Standing Pre: (MATH 1206 or MATH 1226) or (MATH 2015 or MATH 1026). (3H,3C)

#### 3214: FOREST BIOMETRICS

Statistical, mathematical and computer tools for collecting and analyzing data used to make inference or decisions in applications of forest ecosystem science and management. Principles and practices of forest inventory and probability-based sampling. Derivation of volume and weight equations for standing trees. Measures of stand density and site quality. Forest growth and yield modeling. Organization, summary and conveyance of information derived from the data-driven applications into visual, written, and spoken materials of presentation. Pre: 2214, (MATH 2015 or MATH 1026). (3H,3C)

#### 3224: FOREST MEASUREMENTS FIELD LABORATORY

Field practice and computer analysis for collecting and analyzing survey data for use in forest management. Forest inventory and probability-based sampling, stratified sampling, double sampling, regression, and census-based sampling applications. Computer and geospatial tools for analyzing field data. Field assessment of tree and log contents, stand density, and site index. Collection and analysis of growth and yield data. Pre: 2214, 2414. (3L,1C)

#### 3314: FOREST ECOLOGY AND SILVICS

Environmental factors affecting the establishment, growth, and development of forests; silvical characteristics of trees; forest community structure and function; forest ecosystem analysis. Pre: 2314, 2214. (2H,4L,3C)

#### 3324: SILVICULTURE PRINCIPLES AND APPLICATIONS

Theory and practices involved in controlling forest establishment, composition, and growth are developed in a regional context. Formulation of silvicultural systems and the study of reproduction methods, site preparation, intermediate stand manipulations, and reforestation operations. Pre: 3314. (3H,4L,4C)

#### 3344: FOREST FIELD STUDIES

Field observations and discussion of current forestry operations and practices. Junior standing required. A-F only. Pre: 2214. (3L,1C)

#### 3354 (HORT 3354): URBAN FORESTRY AND ARBORICULTURE

Biology, ecology, and management of trees and forested green space in urban and urban-rural interface environments. Life-cycle management of landscape trees, including selection and planting, cultivation and preservation, and utilization and recycling. Urban forest planning, site evaluation, diagnostics, and risk management are emphasized. Pre: (2314 or BIOL 2304 or HORT 2304), (FOR 2324 or HORT 3325 or HORT 3326). (3H,3C)

#### 3364: FOREST ECOLOGY AND SUSTAINABILITY

Survey of the forest, its environment, and its management including forest community structure and function, properties and management of forest soils, and basic silviculture. Partially duplicates 3314. Pre: 2324. (2H,4L,3C)

#### 3454: URBAN FORESTRY FIELD LAB

Field experience in the observation, measurement, and analysis of landscape trees and their urban environments. Hands-on exercises in common arboriculture practices, including diagnostics, tree planting, soil and pest management, tree preservation and protection, pruning, and climbing. Co: 3354. (3L,1C)

#### 3524: ENVIRONMENTAL INTERPRETATION

Interpretation theory and techniques; program planning and evaluation; role of interpretation in enhancing visitor experiences and protecting park resources. Pre: 2554. (2H,3L,3C)

#### 3544: OUTDOOR RECREATION MANAGEMENT

Outdoor recreation management objectives; land acquisition; use measurement; impact assessment; facility operation and maintenance; role of private sector. Pre: 2554. (3H,3C)

#### 3564: OUTDOOR RECREATION PLANNING

Techniques of planning for resource-based outdoor recreation, including: estimation of recreation demand; wildland recreation classification and resource inventory; methods of public involvement; social impact analysis; state comprehensive planning; site design; and values questions associated with these techniques. Pre: 2554. (3H,3C)

#### 3574: ENVIRONMENTAL EDUCATION SERVICE LEARNING

Introduction to key concepts in environmental education and teaching skills through lecture, discussion, service learning, and reflection. Training in internationally recognized environmental education curricula (e.g. Project Learning Tree, Project Wet), in class management and organization skills and in theory relevant to both teaching and learning. Students develop and conduct after school environmental education programs at local elementary schools (2H,3L,3C)

#### 3604: CLIMATE SCIENCE

Physical and biological principles that govern Earth's climate with applications to natural resource management. Mechanisms explaining the causes of past and future climate change. Concepts of system dynamics as applied to the analysis of the climate system. Current and future effects of climate on ecosystem functioning and the associated provision of natural resources. Junior Standing. Pre: MATH 1026 or MATH 1206 or MATH 1226 or MATH 2015. (3H,3C)

#### 3714: FOREST HARVESTING

Principles and application of forest harvesting. Terminology, phases, function, and the interrelationships of people, money, machines, and environment. Pre: 2214. (2H,3L,3C)

#### 3724: FOREST BOUNDARIES AND ROADS

Application of basic land surveying and forest measurement techniques to the location, establishment, and maintenance of forest boundaries and roads. Consideration of stream crossings, best management practices, and costs. Pre: 2214. (2H,3L,3C)

#### 3734: TIMBER PROCUREMENT

Analysis of the U. S. forest industry raw material supply process with emphasis on the evolution and dynamics of timber procurement systems and strategies. Pre: 3215. (2H,2C)

#### 3754: WATERSHEDS AND WATER QUALITY MONITORING

Delivery of water quality constituents from watersheds to water bodies (streams, lakes, and estuaries). Field monitoring methods to assess watershed drivers and how they affect water quality and aquatic ecosystem condition. Linkages among water quality, watershed characteristics, land use and management, and climate. Design of watershed monitoring programs to guide watershed management for protecting water quality and ecological condition of aquatic systems. Pre: BIOL 1106, CHEM 1035, (FOR 2004 or FOR 2114 or FOR 3314 or BIOL 2804 or ENSC 360 4). (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 3964: INTERNSHIP THROUGH DIRECTED FIELD STUDY

Variable credit course.

#### 4014 (NR 4014): NATURAL RESOURCES ECONOMICS

Examination of domestic and international natural resource use, exploitation, and degradation problems, with special focus on use of economics to understand why potential overuse of natural resources exists, and what policy options are available to correct these problems and ensure sustainable natural resource use over time. Water, forests, fisheries, land and exhaustible resources. Permission of instructor may be substituted for the pre-requisite. Pre: ECON 2005 or AAEC 1005. (3H,3C)

#### 4114: INFORMATION TECHNOLOGIES FOR NATURAL RESOURCE MANAGEMENT

An introduction to computer information systems used in natural resources 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 applications will be discussed. Students will receive extensive hand-on instruction in the use of current software packages for DBMS and GIS. Pre: 2214 or GEOG 2314. (2H,3L,3C)

#### 4214: FOREST PHOTOGRAMMETRY AND SPATIAL DATA PROCESSING

Films, filters and camera photogeometry; scale; measurement estimation; image processing; flight planning and photo acquisition; geographic information systems; spatial data analysis techniques and applications. Senior standing required. (2H,3L,3C)

#### 4324 (FIW 4324): GENETICS OF NATURAL AND MANAGED POPULATIONS

Introductory genetics with an emphasis on evolutionary processes relevant to natural and managed populations of both plant and animal species. Traditional and modern genetics, including quantitative and population genetics, molecular evolution, genomics, and biotechnology. Pre: BIOL 1105, BIOL 1106, (STAT 3005 or STAT 3615 or FOR 3214). (3H,3C)

#### 4334 (CSES 4334): PRINCIPLES AND PRACTICE OF AGROFORESTRY

Biological, social, economic, and technical aspects of agroforestry, training and technology transfer techniques, and application of forestry and agriculture principles. Roles of animals and fish, trees, and agricultural crops in agroforestry systems. Community involvement in planning and implementation of agroforestry projects. (3H,3C)

#### 4354: FOREST SOIL AND WATERSHED MANAGEMENT

Properties and processes of soil and water in forests. Emphasis on management for the delivery of ecosystem goods and services. Includes analysis and interpretation in field and laboratory. Pre: CSES 3114 or ENSC 3114 or GEOS 3614 or CSES 3134 or ENSC 3134. (2H,3L,3C)

#### 4364: ADVANCED SILVICULTURE AND FOREST VEGETATION MANAGEMENT

Advanced topics in silviculture with an emphasis on species silvical differences; forest vegetation management and control, herbicides used in forestry, their chemistry, toxicology, application technology; environmental considerations; tree improvement, individual tree growth, and stand dynamics as affected by intermediate silvicultural operations; implications of atmospheric deposition. Pre: 3324. (3H,3C)

#### 4374: 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. Pre: CSES 3114 or CSES 3134. (3H,3C)

#### 4414: ADVANCED WILDLAND FIRE MGMT

Impacts fire has on forest environments; how the environment influences fire behavior; how computer programs aid fire decision making; and how fire is used as a land and vegetation management tool. Influences of weather on fire behavior. The course will also provide students with the knowledge and training to qualify as an advanced wildland firefighter (Squad Boss) (FFT1 - Red Card) and a Virginia Certified Prescribed Burn Manager. Pre: 2514. (2H,3L,3C)

#### 4424: FOREST RESOURCES ECONOMICS AND MANAGEMENT

Application of economics principles and tools to forest decision making from the individual tract to large private and public holdings. Private and public landowner financial incentives and decisions, forest amenities, non-timber forest products, risk, multiple use, management and ownership trends, and sustainability are examined. Pre: 3324 or 3364, or consent of instructor. Pre: 3324 or 3364. (3H,3C)

#### 4434: FOREST RESOURCE POLICY

Historical development of U.S. forest resource policy. Key issues in each of the major forest uses. Policy determination at the federal, state, and private levels. Policy conflict resolution. Senior standing required. Pre: 4424 or ECON 4014 or FOR 4014. (3H,3C)

#### 4444: INTEGRATED FOREST MANAGEMENT PRACTICUM

Student teams apply accumulated discipline-oriented knowledge and techniques to a real forest resource management problem. A practicum in forest resource management and planning, applying multiple use concepts to solve a forest management problem. Senior standing required. Must be Forestry major. (1H,8L,3C)

#### 4454: URBAN FOREST MANAGEMENT AND POLICY

Focuses on the planning, administration, financing and management of trees, forests and green space associated with urban areas and the urban/rural interface. It will include a study of the social needs and values of urban situations; urban tree/forest resource inventories; tree and vegetation ordinances; the

development, financing, and management of tree maintenance programs; and community involvement, public relations, and urban forestry education programs. Senior standing. Pre: 3354. (2H,3L,3C)

#### 4464 (AAEC 4464): WATER RESOURCES POLICY & ECONOMICS

Economic concepts to understand public and private decisions about water use. Current water policies and law. Analytical tools to evaluate policies and address management challenges. Water markets, climate change, and environmental flows. Pre: AAEC 1005. (3H,3C)

#### 4514: FOREST AND TREE PEST MANAGEMENT

Identification and ecology of biotic and abiotic influences on forest and landscape tree health. Developing a theoretical and practical understanding for diagnosing and managing pests and stresses of trees in both the forest and landscape setting. Insects and diseases that attack trees. Pre: 3324 or HORT 3325 or HORT 3326. (2H,3L,3C)

#### 4714: HARVESTING SYSTEMS EVALUATION

Principles and techniques for evaluating harvesting machines and systems design, application, productivity, and financial performance. Pre: 3216, 3424, 3714, 3734. (3H,3C)

#### 4784: WETLAND HYDROLOGY AND BIOGEOCHEMISTRY

Water flows creating wetland hydrologic regime. Hydrologic controls on wetland processes. Linkages between hydrology and biogeochemical cycles. Carbon, nitrogen, phosphorus, and other element cycles within and across wetland boundaries. Field methods to assess hydrologic regime and biogeochemical cycles. Ecosystems services from hydrologic and biogeochemical processes. Applications of wetland hydrology and biogeochemistry in wetland restoration, delineation, and creation. Co: 4374 or FIW 4534 or CSES 4854 or ENSC 4854. (3H,3C)

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Food Science and Technology

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[Degree Requirements](#)

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[Undergraduate Course Descriptions \(FST\)](#)

**Head:** J.E. Marcy

**Professors:** S.E. Duncan, M.L. Jahncke, J.E. Marcy, S.F. O'Keefe, and S.S. Sumner

**Associate Professors:** R.R. Boyer, J.D. Eifert, P.K. Mallikarjunan, M.A. Ponder, and R.C. Williams

**Assistant Professors:** D.D. Kuhn, A.P. Neilson, and A.C. Stewart

**Distinguished Professor Emeritus:** G.F. Flick Jr.

**Professor Emeritus:** N.G. Marriott, M.D. Pierson, and B.W. Zoecklein

**Associate Professor Emeritus:** P.P. Graham

**Adjunct Faculty:** B. Blakistone, H. Bruce, R.E. Croonenberghs, and A.M. Dietrich

**Manager, Consumer Food Safety Program:** M.W. Chase

**Career Advisor:** L.A. Granata

Web: [www.fst.vt.edu](http://www.fst.vt.edu)

E-mail: [fstinfo@vt.edu](mailto:fstinfo@vt.edu)

## Overview

Food science benefits consumers every day with healthier diets, better tasting affordable foods, and increased food safety. In the Department of Food Science and Technology, you really do get to play with your food! Food Science is an exciting area that applies a blend of basic sciences such as biology, chemistry and physics with microbiology, biochemistry, mathematics and engineering to improve the taste, nutrition and value of the world's food supply. The Food Science and Technology curriculum includes hands-on experiences that supports classroom instruction with practical applications and creative

opportunities for product development.

Demand for Food Science and Technology graduates has never been greater. Practically 100% of Virginia Tech's Food Science and Technology graduates have jobs in product development, research, sales and marketing, quality assurance, production management, analytical and technical services and regulatory affairs at graduation. Food processing is the largest industry in the United States. This industry employs nearly 2 million people and accounts for more than 16 percent of the country's gross national product. In a recent survey of U.S. Food Science programs, Virginia Tech ranked 6th nationally in placing Food Science B.S. graduates into graduate or professional schools.

The Virginia Tech Department of Food Science and Technology is the only food science department in Virginia. The program is recognized by the national Institute of Food Technologists (IFT) as having curricula and options that meet the "IFT Undergraduate Education Standards for Degrees in Food Science." Students enrolled in these programs are eligible to apply for IFT Scholarships. The Virginia Tech Food Science Club is a student chapter of the national IFT organization and one of several departmental clubs (New Product Development and College Bowl teams) that permits students to meet professionals in the food industry, develop leadership skills and enhance their educational experience. Students have excellent opportunities for internships as an additional way to explore different facets of the food industry.

Our building is home to a 5,000 square-foot processing area, a pilot-scale dairy processing area, a fully-equipped research winery, a cutting-edge high-pressure processing area as well as laboratories modernly equipped for chemical, physical and microbiological analysis. Due to the department's success and growth we expanded to the new Human and Agricultural Biosciences Building (HABB1) facility which is shared with Biological Systems Engineering. The new facility, located across the street from our present building, provides the department with additional laboratories, pilot plant, taste panel and kitchen facilities, conference rooms, graduate student research spaces and faculty and staff offices. Our faculty and staff received over \$3 million in sponsored research funding last year.

In the Department of Food Science and Technology you may receive a Bachelor of Science in one of three options: Food Business, Food and Health, or Science.

The Department also offers a minor, as well as a double-major option in Food Science and Technology to students in all other colleges of the university. Students completing the science option requirements will also be prepared for graduate schools and professional schools of pharmacy medicine, dentistry and veterinary medicine. Food Science and Technology students have the opportunity to participate in stimulating undergraduate research projects and internships.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)")

and toward the degree.

Satisfactory progress requirements toward the specific degree can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (FST)

### 2014: INTRODUCTION TO FOOD SCIENCE

Fundamentals for food science and technology. Integration of basic principles of food safety, human nutrition, food spoilage, and sensory evaluation with the appropriate technology of food preservation and processing. (2H,2C)

### 2044 (IS 2044) (PSCI 2044): FOOD, WAR AND CONFLICT

Explores the history of food production and processing relative to the commencement or continuation of conflict. Examines why and how wars have been fought over economic policies, food trade and control of food supplies. Examines efforts to protect food and water supplies from intentional contamination and acts of terrorism. Focus on food products and the preservation, processing and distribution technologies that arose from war and conflict. (3H,3C)

### 2544 (HNFE 2544): FUNCTIONAL FOODS FOR HEALTH

Introduction to functional foods (foods with additional value beyond basic nutrition) including development of functional foods, novel sources, and traditional foods with value-added health benefit; regulatory issues; and media messages. (3H,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3024: PRINCIPLES OF SENSORY EVALUATION

Principles of sensory evaluation including theory, sensory physiology and psychology, experimental methods, applications, and statistical analysis. Pre: STAT 3005 or STAT 3615. (3H,3C)

### 3114 (HORT 3114): WINES AND VINES

Principles and standard practices of wine grape production, processing, and sensory evaluation for students with a professional interest in premium table wines. Junior standing and consent required. (2H,2L,3C)

### 3124: BREWING SCIENCE AND TECHNOLOGY

Study of chemical reactions important in brewing of beer and hard cider. Effects of variations in malting, mashing, and other processing steps on characteristics and quality of beer; fruit sugar, acid and fermentation impacts on cider composition and quality. Investigation of reactions that cause flavor deterioration. (3H,3C)

### 3214 (APSC 3214): MEAT SCIENCE

Fundamentals of meat science in meat inspection, carcass evaluation, fabrication, fresh meat, processed meat and product preservation on beef, pork, lamb, poultry, and seafood. Physical, chemical, physiological and microbiological properties of meat as related to composition and quality. Fundamentals in processing techniques, product quality assurance and food safety programs in meat industries. Pre: ALS 2304, BIOL 2604, CHEM 1015. (2H,4L,4C)

### 3514: FOOD ANALYSIS

Data analysis, sampling techniques, theory and practice of chemical and physical methods of food analysis for determination of food composition; application of analytical methods of quality control and food laws and regulations. Pre: STAT 3615, (CHEM 2535 or CHEM 2514). (3H,3L,4C)



#### 3604 (BIOL 3604): FOOD MICROBIOLOGY

Role of microorganisms in foodborne illness, food quality, spoilage, and preservation. Control of microorganisms in foods. Method to enumerate, identify, and characterize microorganisms in foods. Pre: BIOL 2604, BIOL 2614. (3H,3L,4C)

#### 4014: CONCEPTS OF FOOD PRODUCT DEVELOPMENT

Application to the food industry of principles and standard practices of research and product development; functionality of food ingredients; students will work in teams to design and develop a new food product. Pre: 3604. Co: 4504, 4405. (3H,3C)

#### 4104: APPLIED MALTING AND BREWING SCIENCE

Chemistry, biochemistry, and processing aspects of malting and brewing operations in the production of beer. Barley, malting, hops, brewing operations, fermentation and finishing operations examined. Laboratory exercises focused on malting and brewing. With permission of department required. Pre: 3124, 4504. (2H,4L,3C)

#### 4405,4406: FOOD PROCESSING

Basic principles, unit operations, and equipment involved in the commercially important food processing methods and unit operations; materials and containers used in food packaging; food laws, regulations, and standards. Pre: BIOL 2604 for 4405; 3304 for 4406. 4405: (3H,3L,4C) 4406: (1H,3L,2C)

#### 4414: FERMENTATION PROCESS TECHNOLOGY AND INSTRUMENTATION

Process design considerations for food and beverage fermentations, and other industrial fermentation processes. Critical process parameters, and instrumentation for fermentation process monitoring. Hands-on process instrumentation for fermentation. Pre: 4504 or 3604. (1H,2L,2C)

#### 4504: FOOD CHEMISTRY

Consideration of the chemical constituents of foods with emphasis on their role in determining the nutritive value, functional properties, storage characteristics and acceptability of fresh and processed foods. Pre: CHEM 2536, (CHEM 2546 or CHEM 2514), BCHM 2024. (3H,3C)

#### 4524: FOOD SAFETY AND QUALITY ASSURANCE

Monitoring safety and quality of food as well as compliance with government regulations. Description of regulatory agencies and food regulations. Development of specifications, food standards and safety critical control points. Systems to assure a safe and quality product, including acceptance sampling and statistical process control. Pre: 3514, 3604, 4405. (3H,3C)

#### 4534: FOOD CHEMISTRY LAB

Investigation of functional properties of proteins, carbohydrates, and lipids in processed foods including effect of environmental conditions; solubility, foaming ability and textural properties of proteins, carbohydrate crystallization, ability of polysaccharides to form gels and pastes, lipid absorption and tenderization, characterization of a natural-occurring enzyme. Co: 4504. (3L,1C)

#### 4544: DISTILLATION AND FERMENTATION ANALYSIS

Sampling and analysis of pre-and post-fermentation foods and beverages to determine process termination, efficiency, and formation of desired and non-desired products. Laws and regulations pertaining to fermented foods and beverages. Distillation as an analytical tool and as a production method for food/beverage products. Pre: 4504, 3514. Co: 4104. (2H,3L,3C)

#### 4634: EPIDEMIOLOGY OF FOODBORNE DISEASE

Overview of causes, transmission, and epidemiology of major environmental, food, and water borne diseases. Outbreak and sporadic detection, source tracking and control of pathogens. Overview of the impact of foodborne outbreaks on regulatory activities at the national and international level. Corequisite: Enrollment in either FST 3604 or BIOL 4674. Co: BIOL 4674, 3604. (3H,3C)

#### 4644: FERMENTATION MICROBIOLOGY

Physiology, biochemistry, and genetics of microorganisms used for production of food ingredients, fermented foods, and beverages. How microorganisms are used in fermentation and the effects of processing and manufacturing conditions on production of fermented foods. Pre: 4504, 3604. (2H,2C)

**4654: FOOD AND BEVERAGE FERMENTATION**

Introduction to the broad range of fermented foods and beverages. Defining quality parameters of fermented foods and beverages. In-depth examination of the processing methods and equipment employed in commercial-scale production of fermented foods and beverages. Historical, cultural, sensory, and nutritional attributes of fermented foods and beverages. Course requirements may be satisfied by taking FST 3604 or FST 4504 prior to or concurrent with course. Pre: 4504 or 3604. Co: 4644. (1H,2L,2C)

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

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[Undergraduate Course Descriptions \(MTRG\)](#)

**Head:** L. William Carstensen

**Professors:** J.B. Campbell and L.W. Carstensen

**Associate Professors:** A. W. Ellis, L. M. Kennedy, K. N. Kolivras, and L.M. Resler

**Assistant Professors:** T. D. Baird, A. Bukvic, L. Juran, R. D. Oliver, Y. Shao, and S. Zick

**Instructors:** J. D. Boyer, D. F. Carroll, S. Scales, and K. Stiles

**Career Advisors:** L. W. Carstensen and J.B. Campbell

Web: [www.geography.vt.edu](http://www.geography.vt.edu)

## Overview

Geography offers a unique perspective on many of today's most important issues--from globalization, international development, and culture change to environmental problems, population growth, and climate change. Its theories and methods provide analytical techniques applicable to a wide range of questions significant to a broad spectrum of occupations. The geography major provides a balance between an education focusing on contemporary social, political, economic, and environmental issues and training in advanced computer-based techniques.

The department offers courses in human geography, physical geography, and geospatial information science.

Human geography is concerned with the spatial dimensions of human existence, the economy, politics,

and culture; the significance of where people and their activities are located; how the movement of people, resources, and ideas creates links between rural and urban areas and between different regions of the world; the relationships between peoples and their environments; patterns of resource use; how differences and inequalities revealed in spatial patterns affect the quality of life; and how the processes of globalization are transforming regions, countries, and localities.

Physical geographers study patterns of climate, landforms, vegetation, soils, water, and natural hazards and especially the factors and processes that produce those patterns, including human-environment interactions.

Geospatial science involves Geographic Information Systems (GIS), Global Positioning Systems (GPS), web services, and remote sensing. These technologies have led to significant advances in the ways in which geographic information is collected, mapped, analyzed, and integrated in database and decision-making systems. All students are exposed to these technologies as they are integral to working in the field today regardless of specialization and topic of interest. The Department of Geography has excellent technical facilities, including a Geographic Information Systems lab, a remote sensing lab, and a biogeography lab.

Training in geography provides valuable, marketable skills that are in high demand in business, government, and education. Geography majors obtain employment in such diverse fields as geographic information systems, satellite imagery analysis, planning, transportation, marketing, health care, cartography (map making), land and water management, recreation, environmental conservation, and teaching. Employment opportunities are especially strong for students obtaining advanced training in geospatial computer techniques, which are used by both human and physical geographers. Undergraduates in the department have the opportunity to work with local and county agencies while using their geospatial skills to enhance their education and employment prospects.

In addition to fulfilling the requirements of the General Education (Curriculum for Liberal Education) and the core curricula of the College of Natural Resources and Environment, geography majors must also complete 39 hours in geography and related disciplines. All must take GEOG 1004, 1014, 1084, 1104, 2084, 2314, 3314 and one of STAT 2004, 3604, or 3615. Further all students are required to complete a field experience of at least 3 credit hours from 2964, 2994, 3954, 4964, or 4994. The Geography major leads to the B.A. in Geography degree.

## **Degree Requirements**

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## **Minor Requirements**

To graduate with a minor in geography, a student must complete 21 hours of geography, including GEOG 1004, 1014, and 1104; 3 hours from GEOG 2314 or 3314; plus an additional 9 hours of geography classes, of which at least 6 hours must be at the 3000-4000 levels.

### **Geographic Information Science Minor Requirements**

To graduate with a minor in Geospatial information Science, students in Geography or Meteorology

majors must take an additional 12 hours of upper divisional classes in Geospatial Information Science from 4314, 4324, 4374, and 4394, CS 1064, FOR 4114 or FOR 4214.

Students in any major may take this minor by taking 18 hours of Geospatial Information Science coursework including 1084, 2084, 4084, and 4354; plus an additional 6 hours from 3314, 4314, 4324, 4374, 4394, CS 1064, FOR 4114, or FOR 4214.

## Meteorology

The department also offers a B.S. in meteorology as well as a meteorology minor. Our program which integrates Geospatial Information Science and climate science into the meteorology core coursework which allows our graduates to work in the exciting nexus between the atmosphere and the ground beneath it. Today's meteorologists access a wide range of careers in society ranging from forecasting and reporting for multi-media, aiding industry in assessing severe weather impacts on business infrastructure and supply chains, blogging and software development, research, and forecasting for military or federal careers.

In addition to fulfilling the requirements of the General Education (Curriculum for Liberal Education) and the core curricula of the College of Natural Resources and Environment, meteorology majors must also complete 72 hours in geography/meteorology and related disciplines. All must take GEOG 1004, 1014, 1084, 1104, 2084, either 2314 or 3314, 4084, 4354, 4554, one of STAT 2004, 3604, or 3615. Required meteorology courses are 1504, 1514, 2505, 2506, 3504, 2515, 3516, 4504, and 4524,. All also take a rigorous mathematics/physics sequence consisting of MATH 1114, 1225, 1226, 2214, and PHYS 2205, 2215 and 2206/2216 or 2305 and 2306. Further all students are required to complete a field experience of at least 3 credit hours from MTRG 2964, 3524, 3954, 4974, or 4994. The Meteorology major leads to the B.S. in Meteorology degree and provides full credentials to work for the federal government as certified meteorologist.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Minor Requirements

To graduate with a minor in meteorology, a student must complete 21 hours of geography/meteorology coursework, including GEOG 1104, 1514, 2505, 2506 and 3504; plus an additional 6 hours of geography classes, of which at least 3 hours must be at the 3000-4000 levels.

More information is available at <http://geography.vt.edu/programs/Meteorology.htm>. Checksheets with program requirements can be found on the [Office of the University Registrar's website](#).

## Undergraduate Course Descriptions (GEOG)

### 1004: INTRODUCTION TO HUMAN GEOGRAPHY

Introduction to geography as a social science. Development of a conceptual framework for studying and evaluating human-environment relationships. Examination of selected regional and global issues in terms of human and physical attributes of place. (3H,3C)

#### 1014: WORLD REGIONS

Human and physical patterns of major regions of the world. Concepts and perspectives of geography as a social science; linkages and interdependence of nations and regions. (3H,3C)

#### 1084 (FOR 1004): DIGITAL PLANET

Exploration of innovative geospatial technologies and their impact on the world around us, including how humans interact with the environment and each other. Roles of location-based services, global positioning systems, geographic information systems, remote sensing, virtual globes and web based mapping for environmental applications. Skills and techniques for spatial thinking and environmental decision-making. (3H,3C)

#### 1104: INTRODUCTION TO PHYSICAL GEOGRAPHY

Integrated study of major subsystems of the natural environment: the nature, distribution, and interrelationships of landforms, climate and vegetation. (3H,3C)

#### 1115-1116 (NR 1115-1116): SEEKING SUSTAINABILITY

Definition of, conditions of, and strategies for achieving sustainability. 1115: History, current conditions, and trends of sustainability from ecological, economic, and social perspectives. 1116: Detailed conditions and trends, tools for constructing sustainability, integrative project application. (3H,3C)

#### 1504: SURVEY OF METEOROLOGY

An introductory look into the world of meteorology, including the role of forecasters, broadcast meteorologists, current research, and the prediction and response to significant storm events. (1H,1C)

#### 1514: INTRODUCTION TO METEOROLOGY

Introduction to the foundational properties and processes of Earth's atmosphere and the consequential forms and patterns of weather, including atmospheric composition and structure, energy, humidity, clouds and precipitation processes, atmospheric motion, air masses, fronts, and cyclones, and severe weather and hurricanes. (3H,3C)

#### 2004 (NR 2004): INTRODUCTION TO WATER RESOURCES AND ENVIRONMENTAL ISSUES

Introduction to the hydrologic cycle, water resources, and related environmental issues. Emphasis on relationships between human needs for and effects upon water including: factor influencing water quality, droughts, and floods; water for health, energy, and food; water laws, allocation, and conflict; water resources and climate change; and potential solutions for these and other critical water issues. Pre: Sophomore-level standing. (3H,3C)

#### 2034 (IS 2034) (PSCI 2034): GEOGRAPHY OF GLOBAL CONFLICT

Geographical dimensions of global conflicts, international 'management' of conflicts, conflicts of differences, historical, ideological, failed states and resources will be examined. Background to conflicts, current status of conflicts, different points of view in conflict. Topics in the course will change as the geography of global conflict changes. (3H,3C)

#### 2054 (IS 2054) (PSCI 2054): INTRODUCTION TO WORLD POLITICS

An introduction to the prevalent methods and theories in the study of world politics. Topics include: historical context of contemporary world politics, global actors and power relations, international conflict and conflict resolution, international systems, interdependence, trade and integration, international law and prospects for global governance. (3H,3C)

#### 2064 (IS 2064) (PSCI 2064): THE GLOBAL ECONOMY AND WORLD POLITICS

An introduction to the interaction of politics and economics, power and wealth, within the world political economy. Topics include: the international financial system, the dynamics and principles of trade, and the role of transnational firms, as well as issues of environmental protection, sustainable development, and the distribution of wealth and power. (3H,3C)

#### 2084: PRINCIPLES OF GEOGRAPHIC INFORMATION SYSTEMS

Principles and diverse applications of Geographic Information Systems, geographic coordinate systems, Cartesian map projections, spatial data sources, GIS databases, map representations, and illustrated

spatial applications of GIS. Requires regular use of computer systems for geographic data analysis. (3H,3C)

2134 (IS 2134) (PSCI 2134): GEOGRAPHY OF THE GLOBAL ECONOMY

Geographical dimensions of the global economy since World War II. Globalization and the emergence of a new international division of labor. The relative decline of the United States and the growth of Japan, East Asia and the European Union. Changing geographies of foreign direct investment location. Places and regions in geo-economic discourse. Population and resources issues in the early twenty-first century. (3H,3C)

2214: GEOGRAPHY OF NORTH AMERICA

Regional study of Anglo-American with consideration of relationships between natural environments and social, political, and economic developments. International issues involving Mexico also considered. (3H,3C)

2314: MAPS AND MAPPING

Introduction to maps. Fundamentals of reading, analysis, and interpretation of hard copy and digital maps, as they are required to illuminate spatial problems. Influences of maps on attitudes toward and images of the geographic environment. (3H,3C)

2505,2506: WEATHER ANALYSIS I

Introduction to the operational tools and processes in weather forecasting. Surface data and upper-air sounding analysis, forces producing and directing wind flow, jetstreams, weather chart analysis, and atmospheric moisture including clouds and precipitation. (3H,3C)

2964: FIELD STUDY

Pass/Fail only. Variable credit course.

2974: INDEPENDENT STUDY

Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

2994: UNDERGRADUATE RESEARCH

Variable credit course.

3034 (IS 3034) (PSCI 3034): THE CIA: ITS CAPABILITIES IN TODAY'S GEO-POLITICAL WORLD

Role of the discipline of geography in the origins, procedures, and history of CIA. Role of the CIA in providing national intelligence at both strategic and operational levels. Origins and changes to the CIA since WWII. Capabilities to support both policy-makers and national security entities. Case studies illustrating the CIA's operations in different regions of the world. (3H,3C)

3104: ENVIRONMENTAL PROBLEMS, POPULATION, AND DEVELOPMENT

Environmental problems in their social, spatial, and global contexts. Impacts of globalization, population, culture, and poverty on environmental crises. Examination of effects of relations between developed and developing countries on the environment. Focus on selected key environmental issues, such as population growth, agriculture, energy and biofuels, pollution, disasters, land use, and environmental justice. (3H,3C)

3224: GEOGRAPHY OF APPALACHIA

Appalachia as a region: physical environment, development of internal settlement, cultural, and economic patterns. Human adaptations to environmental change, traditions, and connections to and from external regions. Pre: 1004 or 1104 or 1014 or APS 1704 or HUM 1704. (3H,3C)

3244: THE U.S. CITY

The economic, political, and social forces driving urbanization in the United States. The American city in historical context with particular emphasis on the rise of manufacturing, deindustrialization, and suburbanization. Case studies from the manufacturing and sunbelt regions to illuminate key constructs

from urban and human geography. "Border" examples of comparative urbanization from the U.S. - Mexican border, the Caribbean, and Canada. Junior standing required. (3H,3C)

#### 3254: GEOGRAPHY OF EAST ASIA

A geographical analysis of several modern states in East Asia, specifically China, Japan and the Koreas. Economic, political, and cultural change since the end of World War II. Globalization and the emergence of the China as a demographic and economic giant. (3H,3C)

#### 3274: GEORGRAPHY OF SUBARCTIC AND ARCTIC ENVIRONMENTS

Study of circumboreal arctic and subarctic environments from a holistic perspective, with emphasis on cultural, historical, geopolitical, and physical aspects of the North. Importance of arctic and subarctic regions in the global arena. Climate, geomorphology and community change. (3H,3C)

#### 3304 (CSES 3304) (GEOS 3304): GEOMORPHOLOGY

Examines the variety of landforms that exist at the earth's surface. Detailed investigation of major processes operating at the earth's surface including: tectonic, weathering, fluvial, coastal, eolian, and glacial processes. Field excursion. Pre: 1104 or GEOS 1004 or GEOS 2104. (3H,3C)

#### 3314: CARTOGRAPHY

Science and art of cartography including the conceptual framework of the cartographic method. Development of the skills necessary to create maps to be used in the analysis of spatial phenomena for geographic research. Emphasis on thematic cartography. (2H,3L,3C)

#### 3404: MOUNTAIN GEOGRAPHY

Physical characteristics of mountains, such as steep slopes, climatic extremes, and sharp environmental gradients, and their influences on the ways in which people, animals, and plants interact. Physical processes that operate in high-relief environments, including consideration of climate, geomorphology and biogeography. Influence of physical processes in mountain environments on human culture and activities. Cultural significance of mountains. Mountains as a resource. Land use and human-land interactions in mountains. Course is intended for students with an interest in what makes mountains unique and inspiring landscape elements. Pre: 1104. (3H,3C)

#### 3464 (AHRM 3464) (APS 3464) (HD 3464) (HUM 3464) (SOC 3464) (UAP 3464): APPALACHIAN COMMUNITIES

The concept of community in Appalachia using an interdisciplinary approach and experiential learning. Interrelationships among geographically, culturally, and socially constituted communities, public policy, and human development. Pre: Junior standing. (3H,3C)

#### 3504: SEVERE WEATHER

An introduction into mesoscale environments favoring the development of severe thunderstorms and tornadoes, the analysis of moisture, instability and shear parameters associated with severe weather events. Thunderstorm life-cycles, analysis of thermodynamic diagrams, role of wind shear and associated convective mode, hail production and forecasting, tornadogenesis and research. Pre: 2505. (3H,3C)

#### 3515: DYNAMIC METEOROLOGY

Examination of the physics that govern motion of Earth's atmosphere. General atmospheric concepts, atmospheric principles of thermodynamics, hydrostatics, and stability. 3516: Examination of the physics that govern motion of Earth's atmosphere. Principles of fluid dynamics, specifically the physics governing horizontal motion, corresponding vertical motions, and synoptic scale systems, as represented in various coordinate systems. Pre: 2506, MATH 2214, (PHYS 2206, PHYS 2216 or PHYS 2306). (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4044 (BIOL 4044): BIOGEOGRAPHY

A survey of the field of biogeography. A study of the factors influencing the distribution of plants and animals approached from ecological, historical, and cultural perspectives. Human influence on biotic patterns, such as crop domestication, habitat alteration, species introductions and extinctions, management issues, and environmental change, is a primary focus. Pre: 1104 or BIOL 2804. (3H,3C)



#### 4054: GEOGRAPHY OF WINE

Analysis of physical and cultural forces that shape the production, consumption, and great variety of wine in the world. Wine as a complex commodity is examined through its economic, social, political, and ideological impacts in different parts of the world throughout history. Particular emphasis will be focused on place as an agent in defining the product. (3H,3C)

#### 4074: MEDICAL GEOGRAPHY

Geographic patterns of disease and health care at various scales. Study of interactions between the physical environment and health. Analysis of spatial patterns associated with HIV/AIDS epidemic. Examination of health implications of social and cultural variation in developed and developing contexts. Pre: Junior Standing. (3H,3C)

#### 4084: MODELING WITH GEOGRAPHIC INFORMATION SYSTEMS

Use of automated systems for geographic data collection, digitization, storage, display, modeling and analysis. Basic data flow in GIS modeling applications. Development of proficiency in the use of current GIS software. Senior Standing. Pre: 2084. (1H,6L,3C)

#### 4204: GEOGRAPHY OF RESOURCES

Physical and cultural systems that influence the spatial distribution of resources and resource use. Emphasis on historical and current contexts of natural resources use and perspectives in the United States, with consideration of worldwide distributions of resources. Environmental cognition and perception, water, public lands, conservation and preservation, food and hunger, human population, and alternative energy. Junior Standing. (3H,3C)

#### 4214 (UAP 4214) (WGS 4214): WOMEN, ENVIRONMENT AND DEVELOPMENT IN A GLOBAL PERSPECTIVE

Explores intersecting roles of gender, culture, and socio-economic status in people's use of nature, management of environmental resources, and experiences of environmental change. Examines debates on environmental and development initiatives, environmental ethics, and environmental social movements from feminist perspectives. Pre: Junior standing required. (3H,3C)

#### 4314: SPATIAL ANALYSIS IN GEOGRAPHIC INFORMATION SYSTEMS

Theory and application of Geographic Information Systems, with special emphasis on analytical operations, database design, cartographic modeling, and raster GIS. Spatial data handling and analysis to facilitate decision-making through the communication of geographically referenced data. Pre: 4084. (2H,3L,3C)

#### 4324: ALGORITHMS IN GEOGRAPHIC INFORMATION SYSTEMS

Computational methods in automated mapping and map analysis. Visual Basic programming and algorithm design for spatial display and analysis under both raster and vector data models. Requires regular use of the departmental microcomputer and UNIX workstation laboratory. Variable credit course. Pre: 4084, CS 1044.

#### 4334: GEOSPATIAL INFORMATION TECHNOLOGY FOR LAND CHANGE MODELING

Analysis of the spatio-temporal patterns of Land Use and Land Cover Change (LULCC) as observed in satellite images. Tropical deforestation, urbanization, and agricultural intensification. Rates and patterns of LULCC linked to biophysical and socio-economic drivers. Impacts of land change with respect to local climate, biodiversity, water yield and quality, and ecosystem services. Pre: 4084. (3H,3C)

#### 4354 (GEOS 4354): INTRODUCTION TO 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. (2H,3L,3C)

#### 4374: REMOTE SENSING AND PHENOLOGY

Analysis of spatial and temporal patterns of the vegetated land surface as observed by satellite images. Application of satellite image time series to derivation of land surface phenology, and analysis of the appearance and development of phenology in the USA and worldwide. Methods of monitoring of

phenology with satellite imagery. Causes of spatio-temporal changes of phenological events. Effects of global climate change. Pre: 4354. (3H,3C)

#### 4394: INTRODUCTION TO WEB MAPPING

Application of web mapping technologies to geographic data collection, storage, analysis, and display. History and context, spatial data infrastructures, hardware and software architectures, open geospatial consortium standards, mapping APIs, virtual globes, user-centric design, web cartography. Group and individual projects. Pre: 2314 or 3314 or 4084. (3H,3C)

#### 4504: SYNOPTIC METEOROLOGY

Examination of large-scale (1000-5000km) weather systems using both analytical and operational analysis. Topics include thermal structure of atmosphere & resulting circulation, frontal analysis, lifting mechanisms, barotropic/baroclinic systems, and mid-latitude cyclones. Weather pattern influences of the jetstreams and oscillation of large pressure systems including El Nino/La Nina and the North Atlantic Oscillation. Pre: 3504. (3H,3C)

#### 4524: PHYSICAL METEOROLOGY

Study of the physics associated with cloud and precipitation development, the emission, absorption, and transmission of solar and terrestrial radiation, meteorological acoustics, and atmospheric electricity. Pre: 3515. (3H,3C)

#### 4554: REMOTE SENSING OF ATMOSPHERE

Remote sensing technologies used in monitoring weather. Evaluation of Doppler radar products, including base reflectivity, base velocity, storm-relative velocity, and vertically integrated liquid imagery. Could observation through infrared and visible satellite imagery; remote weather station design, set-up and data retrieval. Pre: 4354. (1H,1C)

#### 4764 (SOC 4764) (UAP 4764): INTERNATIONAL DEVELOPMENT POLICY AND PLANNING

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. Junior standing required. (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (MTRG)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 3524: METEOROLOGY FIELD METHODS

A field methods course in meteorology. On-location observation and analysis of temperature, wind fields, pressure, and dewpoint. In-field experiences with radar and satellite data, numerical model output and portable weather stations. On-location sites and corresponding curriculum may include severe storm analysis in the Great Plains, mountain weather in the White Mountains (NH) or Rocky Mountains (CO), and costal storms along the Atlantic or Gulf of Mexico coastlines. May be repeated for credit, with

permission and different content, for a maximum of 9 hours. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course.

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Geosciences

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**Head:** N.L. Ross

**University Distinguished Professors:** R.J. Bodnar, P.M. Dove, G.V. Gibbs (Emeritus), and M.F. Hochella Jr.

**National Academy of Science:** P.M. Dove

**Professors:** R.J. Bodnar, T. J. Burbey, P.M. Dove, K.A. Eriksson, M.F. Hochella Jr., J.A. Hole, S.D. King, R.D. Law, N.L. Ross, M.E. Schreiber, J.A. Spotila, R.J. Tracy, and S. Xiao

**Associate Professors:** R. Weiss and Y. Zhou

**Assistant Professors:** M.J. Caddick, E. Gazel, B.C. Gill, F.M. Michel, S.J. Nesbitt, R.M. Pollyea, B.W. Romans, and D.S. Stamps

**Research Professor:** R.P. Lowell

**Research Associate Professor:** M.C. Chapman

**Associate Professor of Practice:** J.A. Chermak

**Research Scientists:** L. Fedele and M.R. Stocker

**Advanced Instructor:** N.E. Johnson

**Adjunct Faculty:** R. J. Angel, J. Beard, B. DeVivo, A. Dooley, N. Fraser, W. Henika, D. Houseknecht, J. Hunter, R. Koepnick, M. Kowalewski, M. Mikulich, J. Schiffbauer, C. Szabo, L. Ward, and C. Watts

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## Overview

Geosciences offer exciting opportunities for students with an interest in applying a full range of science and mathematical skills to understand the earth's properties and dynamic processes. This is a highly interdisciplinary program that applies physics, chemistry, biology, and mathematics to understand and manage all aspects of Earth and the environment. Geoscientists work everywhere in the world under almost any condition as they search for earth resources, manage the environment and natural hazards, and supervise technical and business enterprises. For more information about exciting careers in Geosciences consult <http://about.agu.org/> and [www.agiweb.org/careers.html](http://www.agiweb.org/careers.html). The extensive scientific and mathematical skills of geoscientists, along with their broad field experience, allow them to pursue careers in many related fields ranging from material science to technical management to scientific reporting.

The internationally recognized faculty in Geosciences has developed four challenging options, described below, that lead to a B.S. in Geosciences. Coursework emphasizes the acquisition and processing of field data beginning with a special course in field methods taken in the spring of the first year. The geology option requires, and the other options recommend, that the student participate in a six-week field camp. The B.S. in Geosciences provides pre-professional preparation that will allow students to continue their education in post graduate programs in science, law, and business.

Earth systems and processes are enormously complicated and require a full range of intellectual skills to decipher and manage. Geoscientists must possess good quantitative skills and a solid understanding of physics, chemistry, and biology. They must be able to read maps, identify rocks, minerals, and fossils as well as visualize earth structures in three dimensions. They must have strong communication skills, both written and verbal. Learning to use these skills in an integrated way is a challenging and rewarding experience.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Geology Option

The Geology option offers a detailed coverage of the broad range of classic disciplines within the geosciences. This option emphasizes the study of minerals, rocks and fossils, and teaches the student how to understand the processes and history of the earth based on the occurrences and relationships of these materials at or near the Earth's surface.

## Geochemistry Option

The Geochemistry option is designed for those students who have special interest in the chemical aspects of the Earth and its materials.

## Geophysics Option

The Geophysics option offers the student the opportunity to specialize in the branch of the geosciences that investigates physical earth processes such as earthquakes and that images the interior of the earth through surface-based physical measurements.

## Earth Science Education Option

The Earth Science education option provides students with a broad earth science curriculum that meets the content goals for secondary earth science teaching. Certification for Earth science teaching is not provided in the program. Information about teaching certification in Virginia can be obtained from the Department of Teaching and Learning.

## Minor in Geosciences

The requirements to earn a minor in Geosciences can be found on its checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Graduate Program

The department offers M.S. and Ph.D. degrees in geosciences with specializations in many sub-disciplines. (See the [Graduate Catalog](#) for further information.)

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Geosciences with any of the available options can be found on the specific major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (GEOS)

### 1004: PHYSICAL GEOLOGY

Minerals and rocks, internal and external processes especially the modification of landscape, global plate tectonics, and their interrelationships; introduction to the more direct aspects of human interactions with the natural physical environment. (3H,3C)

### 1014: THE EARTH AND LIFE THROUGH TIME

Scientific examination of rocks, fossils, and the earth's interior as clues to global-scale geological and biological processes that have shaped our planet and its biosphere through time. Origin and physical evolution of the earth, oceans, and atmosphere; origin and evolution of life; plate tectonics and mountain-building events; global climate changes; major evolutionary innovations; mass extinction events. (3H,3L,4C)

### 1024: RESOURCES GEOLOGY AND THE ENVIRONMENT

The nature, origin, occurrence, distribution, use, and limitations of the earth's mineral resources including abundant and scarce metals, precious metals and gems, building materials, industrial minerals, fossil fuels, nuclear energy, water, soils, and other minerals. (3H,3C)

### 1034: EARTH'S NATURAL HAZARDS

Natural geological hazards, their impact on human civilizations and what they tell us about the workings

of our dynamic planet. Topics include what constitutes hazards and risks, mitigation strategies; tectonic hazards; land surface hazards; atmospheric hazards; solar system hazards. (3H,3C)

#### 1104: PHYSICAL GEOLOGY LABORATORY

Identification of minerals and rocks; topographic maps and air photographs and their use in understanding landscape and geologic influences on human activities; geologic maps. (3L,1C)

#### 1124: RESOURCES GEOLOGY AND THE ENVIRONMENT LABORATORY

Laboratory exercises dealing with the nature of mineral resources, how they are exploited, and the practical concerns associated with their extraction. (3L,1C)

#### 2004: GEOSCIENCE FUNDAMENTALS

Introduction to geoscientific reasoning, methods, written and oral communication, professional expectations, and career options. Scientific methodology, empirical reasoning, and the specific application of these methods to conducting investigations and communicating the results to a geoscientific audience. Introduction to: accessing and using the geoscientific literature, conducting research, collaborating in research groups, using technologies that support collaborative oral and written communication, and building a professional presence. Restricted to Geoscience majors. Pre: (1004, 1014) or (1004, 1024) or (1004, 1034) or (1014, 1024) or (1014, 1034) or (1024, 1034). (2H,3L,3C)

#### 2014: MISSION TO THE PLANETS

The physical, chemical, and geological nature of the terrestrial planets and their atmospheres; similarities and differences between the Earth and other terrestrial planets; manned and unmanned space probes and how they have shaped our understanding of the planets. (3H,3C)

#### 2024: EARTH'S DYNAMIC SYSTEMS

Overview of the geosciences emphasizing processes operating within and on Earth now and over the last 4.55 billion years. Integrates Earth's systems and cycles, includes the rock cycle, hydrologic cycle, origin and evolution of life, extinction. Earth's surface, and atmosphere. Field trips required. Restricted to geoscience majors. Partial duplication of GEOS 1004. (6H,6L,8C)

#### 2104: ELEMENTS OF GEOLOGY

Structure of the earth, properties of minerals and rocks, and geologic processes that act on the surface and in the interior of the earth, and integrated geologic systems of importance in engineering and regional planning. For students in engineering and physical sciences. Geology 2104 duplicates material in Geology 1004 and both may not be taken for credit. (2H,3L,3C)

#### 2444: GEOSCIENCE FIELD OBSERVATIONS

Study of geological phenomena in the field. Students make observations in the field, integrate them into coherent datasets, and construct interpretations. Rock type and structure identification in outcrop. Field techniques and applications in structural geology, sedimentology, stratigraphy, geomorphology, environmental geology, hydrogeology, geochemistry, and geophysics. 10 full days spent in the field (Mondays through Fridays during Summer I), plus additional classroom or laboratory meetings. Pre: 1004, 1014, 1104. (6L,2C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course. X-grade allowed.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 3014: ENVIRONMENTAL GEOSCIENCES

The roles of geology and geophysics in defining and monitoring the natural environment, with special

application to interactions between humans and the geologic environment. Both descriptive treatment and quantitative concepts related to environmental processes involving the solid earth and earth's surface, with emphasis on geologic hazards (e.g., earthquakes, volcanoes, landslides and slope failures, flooding, groundwater problems, mineral and rock dusts). Pre: 1004 or 1024 or 2104. (3H,3C)

#### 3024: FORTRAN FOR PHYSICAL SCIENCE

Computer programming using Fortran 95 with applications to physical science, including statistics, physics, geology, and hydrology. Applications used to expose students to the capabilities of the language will include arrays, I/O concepts, structured programming, data types, procedures and modules, and dynamic data structures. Pre: (MATH 1114 or MATH 2114 or MATH 2114H), (MATH 1206 or MATH 1226) or (MATH 2015 or MATH 1026). (3H,3C)

#### 3034: OCEANOGRAPHY

Descriptive and quantitative treatment of the geological, physical, chemical and biological processes that occur in, or are influenced by, the oceans. The history of oceanic exploration and discovery is addressed. Pre: (MATH 1206 or MATH 1226) or (MATH 2015 or MATH 1026). (3H,3C)

#### 3104: ELEMENTARY GEOPHYSICS

Acquisition and interpretation of exploration geophysical data. Seismic reflection and refraction methods, gravity and magnetic fields, geoelectrical methods, and geophysical well logging. Pre: (MATH 1205 or MATH 1225), (MATH 1206 or MATH 1226), (GEOS 1004 or GEOS 2104), PHYS 2305. Co: PHYS 2306. (2H,3L,3C)

#### 3204: SEDIMENTOLOGY-STRATIGRAPHY

Study of sedimentary basins in a plate-tectonic framework, mechanisms of basin formation, three-dimensional geometry of basin fill, and controls on basin fill. Siliciclastic and carbonate-evaporate rocks as examples of basin fill are discussed in lectures and studied in the lab and in the field. Applied aspects of the course include a discussion of geometries of sedimentary aquifers and reservoirs. Pre: 2004, 2024, 2444. (2H,3L,3C)

#### 3304 (CSES 3304) (GEOG 3304): GEOMORPHOLOGY

Examines the variety of landforms that exist at the earth's surface. Detailed investigation of major processes operating at the earth's surface including: tectonic, weathering, fluvial, coastal, eolian, and glacial processes. Field excursion. Pre: GEOG 1104 or GEOS 1004 or GEOS 2104. (3H,3C)

#### 3404: ELEMENTS OF STRUCTURAL GEOLOGY

Introduction to basic geological structures, evolution of microfolds, development of faults, folds and foliations, stereographic analysis of geological structures, thrust fault geometries, balancing of geological cross-sections, and introduction to the concepts of stress and strain. Pre: 2004, 2024, 2444. (2H,3L,3C)

#### 3504 (MSE 3104): MINERALOGY

Principles of modern mineralogy, crystal chemistry, and crystallography, with emphasis on mineral atomic structure and physical property relationships, mineralogy in the context of geology, geochemistry, environmental science and geophysics, phase equilibria, mineral associations, and mineral identification, and industrial applications of minerals. There are three required field trips during the semester. Pre: 2004, 2024, 2444, CHEM 1036, (MATH 1205 or MATH 1225). (2H,3L,3C)

#### 3604: PALEONTOLOGY

Paleontological principles and techniques and their application to the evolution of life, the ecological structure of ancient biological communities, the interpretation of ancient depositional environments, and the history of the earth. Pre: 1004, 1014. (2H,3L,3C)

#### 3614 (CSES 3114) (ENSC 3114): SOILS

Characterization of soils as a natural resource emphasizing their physical, chemical, mineralogical, and biological properties in relation to nutrient availability, fertilization, plant growth, land-use management, waste application, soil and water quality, and food production. For CSES, ENSC, and related plant- and earth-science majors. Partially duplicates CSES/ENSC 3134. Pre: CHEM 1036. (3H,3C)

#### 3624 (CSES 3124) (ENSC 3124): SOILS LABORATORY



Parent materials, morphology, physical, chemical, and biological properties of soils and related soil management and land use practices will be studied in field and lab. Partially duplicates CSES/ENSC 3134. Co: 3614. (3L,1C)

#### 3704: IGNEOUS AND METAMORPHIC ROCKS

Study of characteristics and mechanisms of igneous intrusion at depth in the crust, volcanic phenomena on the surface, and textural and mineralogical modification of rocks at elevated temperatures and pressures of crustal metamorphism. Tectonic aspects of igneous and metamorphic rocks will be stressed. Pre: 1004, 1014, 3504. (2H,3L,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4024: SENIOR SEMINAR

Investigation and solution of significant geologic research problems by analysis and integration of information across a wide spectrum of Geosciences subdisciplines, and the presentation of results in oral and written form. Research projects will provide maximum student exposure to the full breadth of the Geosciences and the interrelated nature of subdisciplines. Pre: 3104, 3204, 3404, 3504, 3604, 3704. (3H,3C)

#### 4124: SEISMIC STRATIGRAPHY

Overview of seismic data acquisition and processing methods, seismic wavelets, static and dynamic corrections, and seismic velocities; seismic reflection data interpretation; seismic reflection responses Seismic mapping; seismic stratigraphy and seismic lithology. Consent required. Pre: 3104, 3204. (2H,3L,3C)

#### 4154: EARTHQUAKE SEISMOLOGY

Seismicity and its causes in the context of plate tectonics; determination of earthquake location, size and focal parameters; seismogram interpretation; seismometry; hazard potential; use of earthquakes in determining earth structure. Pre: MATH 2214, (MATH 2224 or MATH 2204 or MATH 2204H), PHYS 2305, GEOS 3104. (2H,3L,3C)

#### 4164: POTENTIAL FIELD METHODS IN EXPLORATION GEOPHYSICS

Theory and application to engineering, environmental, and resource exploration. Gravity, magnetics, electrical resistivity, self potential, induced polarization, ground-penetrating radar, magnetotellurics, electromagnetic induction. Pre: 3104, MATH 2214, (MATH 2224 or MATH 2204 or MATH 2204H), PHYS 2306. (3H,3L,4C)

#### 4174: EXPLORATION SEISMOLOGY

Theory and application of seismic methods to engineering, environmental and resource exploration: reflection seismics, refraction seismics, and tomography. Data acquisition, digital filtering, data corrections, imaging, interpretation, and forward modeling. Pre: 3104, (MATH 2224 or MATH 2204 or MATH 2204H), PHYS 2305, PHYS 2306. (3H,3L,4C)

#### 4234: VERTEBRATE EVOLUTION

Characterization of the evolution of vertebrates from the fossil record to now. Tracing anatomical features in humans to their origin of different vertebrate groups. Chronicling vertebrate diversification events through extinctions, changes in climate in the last 600 million years, biogeography, and phylogenetic methods. Evidence of evolution through fossils and dissection. Pre: 1014 or BIOL 2704. (3H,3L,4C)

#### 4354 (GEOG 4354): INTRODUCTION TO 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. (2H,3L,3C)

#### 4404: ADVANCED STRUCTURAL GEOLOGY

Basic principles of rock behavior under applied, non-hydrostatic stress (experimental and tectonic) and analysis of the geometrical patterns produced. Alternate years. Pre: 3404. (2H,3L,3C)

#### 4624: MINERAL DEPOSITS

Introduction to the range and variety of metallic and non-metallic economic mineral deposits. Classification of the petrologic and tectonic settings of mineral deposits. Source, transport and depositional mechanisms of mineral deposit formation. Laboratory emphasizes identification of ore minerals, gangue minerals, common host rocks, wall-rock alteration and mineral zoning. Course requirement of 3 hours of GEOS at the 3000-level or above, may be satisfied by taking prerequisite prior to or concurrent with course. Pre: 1004 or 2104. (2H,3L,3C)

#### 4634: 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 practical approaches to environmental geochemistry. Pre: (MATH 1205 or MATH 1225), CHEM 1036. (2H,3L,3C)

#### 4714: VOLCANOES AND 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. (2H,3L,3C)

#### 4804: GROUNDWATER HYDROLOGY

Physical principles of groundwater flow, including application of analytical solutions to real-world problems. Well hydraulics. Geologic controls on groundwater flow. Pre: (PHYS 2205 or PHYS 2305), (MATH 1206 or MATH 1226 or MATH 2016 or MATH 2024). (2H,3L,3C)

#### 4954: STUDY ABROAD

Variable credit course.

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

May be repeated for a maximum of 4 credits. Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Human Development

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[Undergraduate Course Descriptions \(HD\)](#)

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**Head:** Anisa Zvonkovic

**Alumni Distinguished Professor:** R. Blieszner

**Professors:** K. R. Allen, J. Arditti, M. Boucouvalas, E. E. McCollum, F. P. Piercy, K. A. Roberto, and A. Zvonkovic

**Associate Professors:** M. J. Benson, M. L. Dolbin-MacNab, M. Falconier, A. L. Few-Demo, C. Kaestle, K.J. Kim, T. Savla, and C. L. Smith

**Assistant Professors:** E. Graftsky, J. Jackson, and C. Shivers

**Senior Instructor:** M.E. Verdu

**Advanced Instructor:** K. Gallagher and I. Schepisi

**Instructor:** V. Blanchard, M. Komelski, I. Schepisi, and E. Stachelski

Web: [www.humandevelopment.vt.edu](http://www.humandevelopment.vt.edu)

E-mail: [hdd@vt.edu](mailto:hdd@vt.edu)



## Overview

The Department of Human Development offers undergraduate study of family relationships and of human development across the lifespan. The department's mission is to understand and improve the lives of people of all ages in relationships, families, organizations, and communities.

The program participates in the University Honors Program.

The department offers graduate programs leading to the M.S. in applied human development at the Blacksburg campus, as well as marriage and family therapy at the National Capital Region campus. The department also offers graduate programs leading to the Ph.D. in adult development and aging, adult learning and human resource development, child and adolescent development, family studies, and marriage and family therapy. Graduate students can earn the Graduate Certificate in Gerontology along with their degree or as Commonwealth Campus students (for more information, contact the Center for Gerontology, 237 Wallace Hall, (540) 231-7657). (See [Graduate Catalog](#))

## Human Services

### **Career Advisors: M. E. Verdu**

The degree in human development is for students interested in a wide variety of careers and graduate school programs. The option provides undergraduate majors with a theoretical and experiential grounding in child and adult development and in family and relational dynamics. Course work includes emphases on how individuals and families develop over the life cycle, on the critical issues and events that influence families, and on family transitions and dynamics. The curriculum also focuses on human sexuality, family diversity, and social and public policies that affect individuals and their families. Through course work and field placement experiences, human services students develop and practice skills and communication techniques for working with individuals, families and groups. In addition to course work with the Department of Human Development, human services students take courses in the areas of psychology, sociology, biology, statistics and mathematics, writing and communication, family economics, creative arts, cultural traditions, and international perspectives on human concerns. Students may tailor their studies to their particular professional goals and interests through the use of free electives.

The field study, which integrates theory, research and practice, is a pivotal experience in students' career

development. It increases students' communication and practice skills and helps narrow career interests. Careers open to human services graduates include: preschool, elementary, family & consumer science and special education, employment and job training services, health and wellness programs, housing services, income programs, mental health services, nutrition and meals programs, protective services, recreation programs, respite services, social services, substance abuse programs, volunteer programs, and child care services. Graduate and professional options that human services graduates may consider include business, community health and public health, law, education, family studies, gerontology, marriage and family therapy, medicine and nursing, psychology and sociology, public administration, rehabilitation, and social work.

## **Degree Requirements**

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## **Free Electives (Select 33-35 credits)**

Students are encouraged to consider the wide array of courses across the university curriculum as potential choices for electives to support their Human Services major. In consultation with the major advisor, each student should confirm that prerequisite requirements have been met before enrolling in elective courses.

## **Satisfactory Progress**

A student will be considered to have made satisfactory progress toward the degree when he/she has successfully completed the Curriculum for Liberal Education requirements for English, mathematics, and biology, and HD 1004, by the time the student has attempted 72 semester credits.

## **Undergraduate Course Descriptions (HD)**

### **1004: HUMAN DEVELOPMENT I: CHILDHOOD AND ADOLESCENCE**

Basic concepts related to normal human development. Emphasis on developmental theories and principles of growth, development, and behavior of children from conception through adolescence. Designed as a general survey course for majors and non-majors. (3H,3C)

### **2004: HUMAN DEVELOPMENT II: ADULTHOOD AND AGING**

Introduction to adult development and aging (gerontology). Basic concepts, principles, and issues of development across the adult years. Pre: 1004. (3H,3C)

### **2014: INTEGRATIVE PRACTICES FOR HEALTH, WELLBEING, AND RESILIENCE**

Theories of integrative (mind-body) health and wellbeing. Examination of multidimensional factors (e.g., stress, personality, relationships, & social environment) influencing health across the lifespan. Engagement in evidence-based, therapeutic and preventative practices for promoting health and managing chronic conditions. (3H,3C)

### **2304: FAMILY RELATIONSHIPS**

Overview of basic concepts, principles, theories, and issues of development and change in family relationships. Topics include families in historical and contextual perspective, structural and relational

diversity in families, and processes of relational development, maintenance, and dissolution in families. (3H,3C)

#### 2314: HUMAN SEXUALITY

Explores the diversity of human sexuality using global perspectives. Biological, historical, developmental, psychological, and sociological approaches frame this interdisciplinary examination of the social constructions of sexuality, the processes of gender stratification, and the development of sexual practices, rituals, mythologies, and belief systems across time and around the world. (3H,3C)

#### 2335-2336: PRINCIPLES OF HUMAN SERVICES

2335: Basic concepts, techniques, and structure of the human services profession. Survey of client/family assessment and problem management. 2336: Advanced topics in human services focusing on: case management, crisis intervention, program administration, specialized interventions, ethics, and professional development. Pre: 1004 for 2335; 2335 for 2336. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 3014: RESEARCH METHODS IN HUMAN DEVELOPMENT

Critical thinking and problem-solving involved in applying methods of scientific inquiry to the field of human development. Topics include methods of data collection, basic methods for displaying and analyzing data, and writing reports. Pre: 2004, 2304, STAT 3604. (2H,1L,3C)

#### 3114: ISSUES IN AGING

Seminar which investigates selected contemporary issues in adulthood and old age, such as family and friend relationships; work and retirement; political, legal, and economic issues; and women's concerns. (3H,3C)

#### 3144 (EDCI 3144): EDUCATION OF EXCEPTIONAL LEARNERS

Emphasizes legal, ethical, and economic bases, assessment and eligibility requirements, characteristics and educational implications, and practices pertaining to various exceptionalities. (3H,3C)

#### 3214: INFANCY AND EARLY CHILDHOOD

Theories, principles, normal patterns of physical, cognitive, social, and emotional development from conception to the early school years. Micro and macro environmental influences on development are considered as they interact with genetic/biological determinants of development. Pre: 1004. (3H,3C)

#### 3224: MIDDLE CHILDHOOD AND ADOLESCENCE

Theories, principles, normal patterns of physical, cognitive, social, and emotional development from middle childhood to adolescence. Micro and macro environmental influences on development are considered as they interact with genetic/ biological determinants of development. Pre: 1004. (3H,3C)

#### 3234: LIFESPAN COMMUNITY SERVICES

Health and human service programs serving children, youth, older, adults, and families. Overview of community programs for individuals and families over the lifespan; methods of determining service eligibility; procedures for maintaining quality assurance. Pre: 1004, 2304, 2004. (3H,3C)

#### 3304: ADVANCED HELPING SKILLS

Helping skills used in human services settings. Case management, evaluating crisis situations, and approaches to individual and family assessment. Pre: 2335, 2336. (3H,3C)

3464 (AHRM 3464) (APS 3464) (GEOG 3464) (HUM 3464) (SOC 3464) (UAP 3464): APPALACHIAN COMMUNITIES

The concept of community in Appalachia using an interdisciplinary approach and experiential learning. Interrelationships among geographically, culturally, and socially constituted communities, public policy, and human development. Pre: Junior standing. (3H,3C)

3954: STUDY ABROAD

Variable credit course.

4304: HUMAN SERVICES ADMINISTRATION

Issues, functions, and responsibilities involved in developing, implementing, and evaluating family and human services programs. Pre: 3234 or 3114. (3H,3C)

4324: ADVANCED FAMILY RELATIONSHIPS

Investigation of challenges, stresses, and crises experienced by individuals and families; protective factors and resilience; coping strategies; prevention and intervention; public policies. Pre: 2304. (3H,3C)

4324H: ADVANCED FAMILY RELATIONSHIPS

Investigation of challenges, stresses, and crises experienced by individuals and families; protective factors and resilience; coping strategies; prevention and intervention; public policies. Pre: 2304. (3H,3C)

4334: PERSPECTIVES ON ADDICTION AND FAMILY SYSTEMS

Intra-personal and inter-personal dimensions of compulsive- addictive patterns manifested in the context of the family system. Reciprocal interaction between families and other systems. Junior standing required. Pre: 2304 or 2314. (3H,3C)

4354: FAMILY, LAW, AND PUBLIC POLICY

Theoretical and substantive issues that relate to the development and implementation of family policies. Implications of political culture and family legislation for the well-being of children and their families. Pre: 1004, 2335, 2336, 2004, 2304. (3H,3C)

4354H: FAMILY, LAW, AND PUBLIC POLICY

Theoretical and substantive issues that relate to the development and implementation of family policies. Implications of political culture and family legislation for the well-being of children and their families. Pre: 1004, 2335, 2336, 2004, 2304. (3H,3C)

4364: GENDER AND FAMILY DIVERSITY

Examination of the changing character of individual and family diversity, as related to the intersections among gender, race, class, sexuality, age, and ability. Junior standing required Pre: 2304. (3H,3C)

4714: SENIOR CAPSTONE SEMINAR

Intensive learning experiences in critical thinking and analysis. Opportunities to demonstrate breadth of learning while developing leadership skills and honing professional competencies. Topics include leadership and team development, problem solving, grant writing, program evaluation, and electronic portfolios. Senior standing in Human Services required. (3H,3C)

4964: FIELD STUDY

Variable credit course. Pre: 1004, 2004, 2335, 2336.

4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## History

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**Chair:** Mark V. Barrow, Jr.

**Associate Chair:** Trudy Harrington Becker

**Professors:** M.V. Barrow Jr., F.J. Baumgartner, A.R. Ekirch, E.T. Ewing, R.F. Hirsh, and P.R. Wallenstein

**Associate Professors:** G.R. Bugh, B. Bunch-Lyons, H. Gumbert, M. Heaton, K. Jones, M. Mollin, A. Nelson, P. Quigley, P. Schmitthenner, H. Schneider, B. L. Shadle, N.L. Shumsky, R. Stephens, and D.B. Thorp

**Assistant Professors:** D. Agmon, D. Cline, J. Felt, C. Gitre, D. Halpin, D. Hidalgo, M. Kiechle, W. Milteer, and L. Winling

**Senior Instructor:** T. H. Becker

**Adjunct Professors:** J. Berkley-Coats and B.J. Reeves

Web: [www.history.vt.edu](http://www.history.vt.edu)

## Overview

The study of history enables students to learn about the people and events of the past. In the process, it also helps them develop their ability to think logically, to conduct research, and to analyze the various ways in which the past continues to shape the present.

The history curriculum prepares students for graduate or professional schools; positions in teaching, business, or government; and a variety of other careers. Faculty advisors are available to consult with students regarding career choices, education certification, and internships, as well as to provide assistance in planning general academic progress. An honors program is offered for outstanding history

majors.

Courses at the 1000 level are introductory surveys open to anyone with an interest in history but without a strong background in the subject. Students intending to continue in history should take these courses in their freshman or sophomore years. Courses at the 2000 level, with the exception of Historical Methods, are national surveys for a general undergraduate audience. Courses at the 3000 level, primarily for sophomores and above, provide more focused and detailed study of a period, place, or topic introduced at the 1000 or 2000 level. Courses at the 4000 level are conducted as seminars that emphasize original writing and research, and are generally restricted to students with junior standing or above who have already taken six hours or more of college-level history.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

Majors may select a concentration within the history major. Concentrations require that at least 12 of the 24 hours of history taken at the 2000 or 3000 level be appropriate to the field of concentration, and the completion of 6 hours of undergraduate research. Concentrations are available in:

Military/Political/Diplomatic History; Social/Cultural/Economic History; Global/Comparative History; and History of Science/Technology/Environment.

A faculty advisor and/or professional advisor will assist each major in planning a suitable course of study. The student is expected to confer with the faculty advisor at regular intervals regarding the progress of his or her studies.

**To earn a minor in history**, a student must complete satisfactorily (with at least a 2.0 average) a minimum of 18 hours of history courses. You may find requirements by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in history.

Satisfactory progress requirements toward the B.A. in history can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (HIST)

### 1004: INTRODUCTION TO HISTORY

Introduces students to the main concepts and issues of discipline of history. Familiarizes students with the Department of History, educational requirements, university resources, and career opportunities for History majors. (3H,3C)

### 1024: ANCIENT HISTORY

History of the ancient world from the invention of writing after 10,000 BC to the fall of the Roman Empire in the fifth century AD. Surveys the civilizations of the Ancient Near East (including Egypt and Anatolia), Greece, and Rome. (3H,3C)

1025,1026: INTRODUCTION TO EUROPEAN CIVILIZATION

Significant problems and processes in the history of Europe from the Middle Ages to the recent past.

1025: From Medieval society to the mid-18th century; 1026: Mid-18th-century to the recent past.

Sequence is recommended in preparation for advanced courses in European history. (3H,3C)

1115,1116: HISTORY OF THE UNITED STATES

Stresses fundamental facts and interpretations in American history. 1115: 1607 to Civil War; 1116: Civil War to present. Sequence is recommended preparation for advanced courses in American history.

(3H,3C)

1214: HISTORY OF THE MODERN WORLD

An examination of the global significance of the critical political, social, cultural, and international issues in the 20th century. (3H,3C)

1215,1216: INTRO TO WORLD HISTORY

Examines key subjects and themes in world history from the beginnings of human civilization to the recent past. 1215: to 1500 CE. 1216: 1500 CE to present. (3H,3C)

1224: INTRODUCTION TO LATIN AMERICA

The peoples of Latin America from the earliest times to the present. Historical approach to understanding ancient and contemporary cultures, their environmental impact, and their socio-political dynamics from Mexico to Tierra del Fuego over 5000 years. (3H,3C)

1515,1516: HISTORY OF AFRICA

Examines key subjects and themes in African history from the beginnings of human civilization to the recent past. 1515: Early civilizations through the abolition of the slave trade. Examines migrations and trade, the expansion of Islam, and slavery in Africa and the Atlantic and Indian Oceans. 1516: Africa since the nineteenth century. Examines European conquest, and major political, cultural and social changes during the colonial and post-colonial eras. (3H,3C)

2004: HISTORICAL METHODS

Explanation of the discipline of history: its history, philosophies, and methods, with emphasis on historical research. (3H,3C)

2054 (STS 2054): ENGINEERING CULTURES

Development of engineering and its cultural roles in historical and cross-national perspectives. Explores roles of engineers and engineering in popular life, development of national styles, changing values in engineering problem solving, and effects of evolving forms of capitalism. (3H,3C)

2104H: CRITICAL ISSUES IN AMERICAN HISTORY

This course allows Honors students to explore more thoroughly selected themes in the history of the United States, from its initial settlement to the present. Students must have University Honors status or permission of the instructor to take this course. (3H,3C)

2114H: CRITICAL ISSUES IN EUROPEAN HISTORY

An exploration of critical issues in modern European history, through the study of source materials and historical interpretations. University Honors standing is required. (3H,3C)

2124: CRITICAL ISSUES IN WORLD HISTORY

An examination of significant themes and important topics in world history. (3H,3C)

2165,2166: HISTORY OF FRANCE

French history from Roman Gaul to the present. 2165: Roman, Medieval, and Renaissance France; Absolute Monarchy. 2166: The Revolution; Nineteenth and Twentieth Century France. (3H,3C)

#### 2184: HISTORY OF THE BALKANS

History of Southeastern Europe from the sixth century to the present. Chief themes are movement of peoples, Byzantine and Ottoman Empires, religious conflicts, social developments, and rival nationalisms. (3H,3C)

#### 2304: AFRICA IN THE MODERN WORLD

The peoples and societies of Africa. Emphasis on major themes and developments since the eighteenth century. Historical approach to understanding indigenous African cultures and their encounters with global forces. Concentration on African achievements, the response to colonialism, the rise of modern nationalism, and the problems and prospects of independent Africa. (3H,3C)

#### 2345,2346: HISTORY OF THE MIDDLE EAST

History of the Middle East from the seventh century to today, with emphasis on formation of Islamic civilization, medieval and early modern political systems, European imperialism, and the struggle for independence. 2345: seventh century to 1914; 2346: independence, wars, revolutions, and social change since 1914. (3H,3C)

#### 2355,2356: HISTORY OF CHINA

China from prehistory to the present. Special attention to political, social, economic, and cultural developments. 2355: Prehistory, Imperial China to the sixteenth century; 2356: late Imperial China to modern and contemporary China. (3H,3C)

#### 2364: HISTORY OF JAPAN

Political, social, economic, and cultural development of Japan from earliest times to present; emphasis on problems of modernization in the nineteenth and the twentieth centuries. (3H,3C)

#### 2375,2376: HISTORY OF THE INDIAN SUBCONTINENT

History of the Indian subcontinent (South Asia) from ancient times to the present, with special emphasis on cultural developments. 2375: Development of traditional South Asian civilization from ancient times to 1500; 2376: Development of modern South Asian civilization since 1500. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2984H: SPECIAL STUDY

Variable credit course.

#### 3004: COLONIAL AMERICA

Critical analysis of early American society. Founding and development of the colonies in the 17th century; 18th century colonial life. (3H,3C)

#### 3014: THE AMERICAN REVOLUTION

Causes, nature, and results of the American Revolution, 1763- 1789. (3H,3C)

#### 3054: THE AMERICAN CIVIL WAR

Explores the causes, course, and consequences of the American Civil War, with particular emphasis on transformations in regional and national identity, race relations, governance, gender roles, military affairs, and the United States' place on the world stage. (3H,3C)

#### 3064: EMERGENCE OF MODERN AMERICA, 1877-1917

American from end of Reconstruction to World War I: industrial and urban growth, the last frontier, worsening status for blacks, immigration and new ethnic currents, Populism and Progressivism, cultural ferment, and overseas expansion, America's entry on the world stage. (3H,3C)

#### 3084: RECENT AMERICA, 1917-PRESENT

Social, economic, cultural, and political history of America from the entry into World War I, the turbulent 1920s, the Great Depression, the New Deal, World War II, postwar prosperity, the Cold War, social and cultural ferment, Vietnam, Watergate, to the new anxieties about the limits of power in the 1980s. (3H,3C)

#### 3104: UNITED STATES SOCIAL HISTORY

Examination of the lives of ordinary people in order to understand the human experience through a focus on race, ethnicity, class, gender, and region. (3H,3C)

#### 3105,3106: WOMEN IN U S HISTORY

Roles of women from colonial settlement to the present. Special attention to family experiences, political agendas, and economic contributions of women and to social construction of gender identities. 3105: to 1865; 3106: since 1865. (3H,3C)

#### 3114: UNITED STATES BUSINESS HISTORY

Survey of U.S. business history from colonial times through the present. Formation of business institutions, specialization of commercial functions, rise of big business, and development of oligopolies, conglomerates, and multinational corporations. (3H,3C)

#### 3134: SPORTS IN AMERICAN HISTORY

Impact of sports in American history. Emphasis on the impact of team sports (college and professional basketball, baseball, and football) and individual sports (golf, boxing, and automobile racing) have had on the development of American society and culture. (3H,3C)

#### 3144: AMERICAN ENVIRONMENTAL HISTORY

Changing attitudes about nature and wilderness, political decisions, supervisory institutions, and environmental problems that accompanied utilization of America's natural resources. (3H,3C)

#### 3155,3156: HISTORY OF AMERICAN CITIES

Growth and development, form and functioning of American cities from the settlement of the country to the present. 3155: 1565 to 1870. 3156: 1870 to the present. (3H,3C) I,II.

#### 3164: SEXUALITY IN AMERICAN HISTORY

This course introduces students to how the meaning and place of sexuality in American life have changed from the colonial era through the present, with a focus on the dynamics of race, ethnicity, gender, and class. (3H,3C)

#### 3175,3176 (AFST 3175, 3176): AFRO-AMERICAN HISTORY

The Afro-American experience in the United States from 1619 to the present. Emphasis upon slavery and the strategies of economic and social survival in the twentieth century. 3175: 1619-1877. 3176: 1877-present. (3H,3C)

#### 3205,3206: U.S. SOUTH

The southern experience from Old to New South with emphases upon racial accommodation, social hierarchy, cultural identity, political struggle, and intellectual change. 3205: to 1900; 3206: since 1900. (3H,3C)

#### 3214: HISTORY OF APPALACHIA

Early settlement, religion, the pre-industrial economy, the coming of the coal and lumber industries, labor activism, politics, migration, and regional identity. (3H,3C)

#### 3224: HISTORY OF VIRGINIA

Social, political, cultural, and economic developments in Virginia, from the sixteenth century to the present. (3H,3C)

#### 3234: THE NORTH AMERICAN WEST

A study of the peoples and history of the North American West from the sixteenth century through the twentieth. (3H,3C)

#### 3254: THE VIETNAM WAR

A critical study of the causes and consequences of the Vietnam War, 1945-1975. Analysis of America's strategic and military objectives, the nature and conduct of the war, and the growth of the antiwar movement at home. (3H,3C)

#### 3274: THE GREEK CITY

History of the ancient Greek city-state (polis) from the Archaic period (800-500 BC) to the creation of the Roman Empire. Principal topics are: origins and definition of the polis; Greek colonization throughout the Mediterranean and Black Seas; the struggle for autonomy in the Classical and Hellenistic periods; and the Hellenizing impact of the polis on non-Greek populations. (3H,3C)

#### 3284: THE ROMAN REVOLUTION

History of the Roman world from 264 B.C. to A.D. 180. Particular attention to the three themes of imperialism, revolution, and empire through extensive reading of the contemporary authors. (3H,3C)

#### 3294: ROMAN BRITAIN

Examines the social, political, and military origins of early England from Stonehenge to the Norman Conquest; emphasis on archaeology and material culture; and the legacy of the Romans and Romanization on forging a British identity. (3H,3C)

#### 3304: THE WORLD OF ALEXANDER THE GREAT

The life and times of Alexander the Great, 431 to 323 B.C., and the new cosmopolitan world initiated by his conquests, 323 to 30 B.C. (3H,3C) II.

#### 3314: THE LATER ROMAN EMPIRE

Roman Empire in the west from A.D. 180 to A.D. 476 and in the east from A.D. 476 to A.D. 1071. Particular attention to the causes of the fall of the empire in the west and to the Byzantine Empire in the east until the coming of the Turks and the Christian Crusaders. (3H,3C)

#### 3324: THE MEDIEVAL WORLD

Characteristic thought and institutions of high and late Middle Ages. (3H,3C)

#### 3334: THE RENAISSANCE

The Italian Renaissance in its European context. Emphasis upon the culture and institutions of Italian states from 1300 to 1500. (3H,3C) II.

#### 3344: THE ERA OF THE REFORMATION

Development of Protestantism and reformation of the Catholic Church from 1500 to about 1600. Emphasis upon social, political, and economic factors as well as theology. Examination of conflicts engendered by the reformation movements. (3H,3C)

#### 3364: THE AGE OF REVOLUTION AND NAPOLEON

The French Revolution in its European and global context, with particular attention to social and political causes of unrest, strategies of popular mobilization, debates about authority and order, the emergence of empires, and the long-term implications of revolutionary change. (3H,3C)

#### 3394: EUROPE SINCE WORLD WAR II

Europe's political and economic recovery since 1945; development of the "Cold War"; Soviet Union and Eastern Europe before and after Stalin; Western European integration and development of a consumer society; Ostpolitik and Detente; decolonization and neo-colonialism; Europe's position in the world economy, dependence on imported materials and energy; the Revolutions of 1989 and post-Marxist Eastern Europe. (3H,3C)

#### 3424: TUDOR AND EARLY STUART ENGLAND, 1509-1660

Causes and consequences of the English Reformation and subsequent Civil War. Decline of royal power and increasing importance of Parliament. Cultural and intellectual developments of the Elizabethan period. (3H,3C)

#### 3484: TWENTIETH-CENTURY GERMANY

Political, social, economic, and cultural history of twentieth-century Germany. (3H,3C)

#### 3494 (JUD 3494) (RLCL 3494): THE HOLOCAUST

This course provides a historical account, a psychological analysis, and an occasion for philosophical contemplation on the Holocaust. We will examine the deliberate and systematic attempt to annihilate the Jewish people by the National Socialist German State during World War II. Although Jews were the primary victims, Gypsies, the handicapped, homosexuals, Jehovah's Witnesses and political dissidents were targeted; we will discuss their fate as well. The class will be organized around the examination of primary sources: written accounts, photographic and film, and personal testimony. (3H,3C)

#### 3504 (RLCL 3504): THE AGE OF THE CRUSADES

The origins and development of religious violence examined from an interdisciplinary and cross-cultural perspective; that place of that phenomenon in medieval society. Christianity, Islam, Judaism and their interactions in the medieval world. (3H,3C)

#### 3524: EUROPEAN MILITARY HISTORY TO 1789

Analysis of change in warfare from the ancient Greeks to the French Revolution. Emphasis on the social and technological causes of military change. (3H,3C)

#### 3534: MODERN MILITARY HISTORY

Evolution of warfare in its political and social setting since the French Revolution. Discussion of both European and American military institutions. (3H,3C)

#### 3544: WORLD WAR II

Causes, course, and results of World War II. Emphasis upon diplomacy and the social impact of total war as well as military events. Coverage will stress the world-wide nature of the war. (3H,3C)

#### 3554: AGE OF GLOBALIZATION

An examination of historical forces in the late twentieth century, including economic trends, ideological forces, social structures, and political relations, that have shaped patterns of globalization. (3H,3C)

#### 3584: COLONIAL LATIN AMERICA

Major themes and issues in Colonial Latin American History. Discussion of the Spanish and Portuguese empires in the western hemisphere, emphasizing indigenous responses to colonization, the privatization of land and labor, the Church and village as financial and cultural institutions, imperial policies and reforms, and the collapse of empire after 300 years. I (3H,3C)

#### 3594: THE RISE OF MODERN LATIN AMERICA

Major themes and issues in Modern Latin American History. Discussion of the rise of Latin American nations, stressing the internal and external challenges new republics confronted during the nineteenth century and the opportunities and conflicts of the twentieth century. (3H,3C)

#### 3604: RUSSIA TO PETER THE GREAT

Russian history from the founding of Russia in the ninth century to the reign of Peter the Great in the early eighteenth century, with special attention to political developments, changes in society and culture and regional context. (3H,3C)

#### 3614: IMPERIAL RUSSIA

Russian history from Peter the Great to the Revolution of 1917, with special attention to political developments, changes in society and culture, and the impact of the regional context. (3H,3C)

#### 3624: HEALTH AND ILLNESS IN AFRICAN HISTORY

Examines key subjects and themes in the history of health, medicine, and disease in African history. Topics include indigenous health systems, colonial medicine, and post-colonial health crises, including

HIV/AIDS. (3H,3C)

**3634: MAU MAU: COLONIALISM AND REBELLION IN KENYA**

Examines the social, political, economic, and cultural origins of the Mau Mau rebellion in Kenya; insurgency and counter-insurgency; and the continuing debates in Kenya over the meaning of Mau Mau. (3H,3C)

**3644: TWENTIETH-CENTURY RUSSIA**

The history of the Soviet Union from 1917 to the present, with particular emphasis on collectivization, industrialization, ideology, international relations, and other factors that have determined the peculiar character of the Soviet state. (3H,3C)

**3654: THE ARAB-ISRAELI DISPUTE**

Historical origins and development of the struggle for Palestine. Emphasis on post-WW II including conflicting nationalisms, wars, history of Israel, and Great Power diplomacy. (3H,3C)

**3664: REVOLUTIONARY CHINA**

Ideological and institutional development of the Chinese Communist movement since 1920; emphasis on problems of historical change in modern China. (3H,3C)

**3674: TOPICS IN CHINESE HISTORY**

Examination of variable topics in Chinese history, ranging from the beginnings of civilization to the recent past. Examines the primary sources and historiographic debates of a particular issue. Explores the diversity within China and its relationship with the rest of the world. Can be repeated with different content up to 9 hours. (3H,3C)

**3684: CULTURAL HISTORY OF THE SOVIET UNION AND THE SUCCESSOR STATES**

History and main characteristics of cultural life and the arts in the former Soviet Union, with emphasis on film, music, literature, and the relationship between elite and popular culture. (3H,3C)

**3694: HISTORY THROUGH FILM**

This course introduces students to critical issues in history and representation, utilizing film to analyze central historical issues. The specific thematic content is variable. Course may be repeated for up to 9 credits. (2H,3L,3C)

**3705,3706 (STS 3705, 3706): HISTORY OF SCIENCE**

Conceptual and institutional development of physical and biological sciences viewed within a cultural and societal context. 3705: Early Science; 3706: Modern Science. (3H,3C)

**3715,3716 (STS 3715, 3716): HISTORY OF TECHNOLOGY**

Description of the development of technology and engineering in their social contexts. 3715: From prehistory to the industrial revolution in Europe and the United States, mid-19th century. 3716: From mid-19th century to the present. (3H,3C)

**3724: HISTORY OF DISEASE, MEDICINE, AND HEALTH**

Development of Western concepts of disease, medicine, and health with emphasis on period from eighteenth century to present. Social construction of disease and relationship between health and social, economic, and political structures. Special attention to impact of public health and the development of scientific and technological medicine. (3H,3C)

**3734 (STS 3734): HISTORY OF MODERN BIOLOGY**

This course explores the development of biology from the Enlightenment to the end of the twentieth century, with a particular emphasis on biology's impact on society. (3H,3C)

**3744: SOCIAL HISTORY OF FILM**

This course introduces students to critical issues in the social history of film, examining the production and consumption of film in specific historical moments as well as the effects of film on society, culture, and politics. The specific thematic content is variable. May be repeated with different content for a maximum of 9 credits. (3H,3C)



**3754: PUBLIC HISTORY**

Investigation of the ways which historians research, interpret, and present the past to the public. (3H,3C)

**3764: ORAL HISTORY: METHODS AND PRACTICES**

Explores the theory and methodology of oral history practice. Considers the use of oral history interviews in historical research, and explores questions of ethics, interpretation, and the construction of memory. Includes training in technical operations and a variety of interview techniques, transcription, and historical use of interviews. (3H,3C)

**3774: DIGITAL HISTORY**

Develops skills and methods for researching and presenting history in a digital environment, with special emphasis on use of digital media as a tool for public historians. (3H,3C)

**3914: CRITICAL READING AND ANALYSIS IN HISTORY**

Develops critical reading skills in history. Demonstrates that historical knowledge is part of a scholarly conversation that grows and evolves over time. Assesses the critical role of interpretation in history, investigates historical controversies and debates and develops skills to evaluate historiographical trends. Pre: 2004. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course.

**3984: SPECIAL STUDY**

Variable credit course. X-grade allowed.

**4004: TOPICS IN SOCIAL AND CULTURAL HISTORY**

Selected topics in social and cultural history. May be repeated with different content. 3 other hours of history and junior standing required. Pre: 2004. (3H,3C)

**4074 (RLCL 4074): TOPICS IN RELIGIOUS AND INTELLECTUAL HISTORY**

Selected topics in the role of religion and intellectual systems in human history. May be repeated with different content. 3 other credits of history and Junior standing or above required. Pre: 2004. (3H,3C)

**4914: HISTORY RESEARCH SEMINAR**

Variable topic, writing-intensive, capstone course for history majors. Provides in-depth knowledge of a specific historical subfield. Utilizes archival historical sources, online research databases, and existing literature to create an original work of historical scholarship. May be repeated with different content up to 6 hours. Junior standing or above required. Pre: 3914 or 3904. (3H,3C)

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course. X-grade allowed.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Human Nutrition, Foods, and Exercise

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[Dietetics](#)

[Science of Food, Nutrition, and Exercise](#)

[Satisfactory Progress](#)

[Undergraduate Course Descriptions \(HNFE\)](#)

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**Head:** Matthew W. Hulver

**Professors:** K. P. Davy, P. A. Estabrooks, M.W. Hulver, S. M. Hutson, J. W. Rankin, and J. H. Williams

**Associate Professors:** W. E. Barbeau, B. M. Davy, D. J. Good, R. W. Grange, D. Liu, E. M. Schmelz, E.L. Serrano, Y. H. Ju, and J. Zoellner

**Assistant Professors:** F. Almeida, Z.Cheng, M. Frisard, S. Harden, V. Hedrick, J. L. Hill, and V. Kraak

**Senior Instructor:** C. B. Papillon

**Advanced Instructor:** H.K. Cox

**Instructors:** R. Eaton and N. Girmes-Grieco

**Adjunct Instructors:** M. D. Lewis

Web: [www.hnfe.vt.edu](http://www.hnfe.vt.edu)

## Overview

Nutrition, foods, and exercise science is a unique field of study that builds on the biological and physical sciences. Human nutrition is directed toward helping people choose food that meets their physiological needs and is consistent with their lifestyles and cultural preferences. Changes in lifestyle and food consumption patterns have created consumer demand for new food products that are shelf stable, require little or no preparation, and are appropriate in nutrition content. These trends have increased the need for food professionals who wish to apply their science background to exploring the nutrient content and

chemical and physical properties of foods and food ingredients. Increasing interest in physical fitness and wellness has brought about new professional opportunities in assisting people who want to develop appropriate exercise patterns and make healthy changes in their lifestyle.

Many contemporary health issues including obesity, heart disease, and cancer have been associated with a person's food intake and level of exercise. This has led to increasing emphasis on health promotion and disease intervention, and the nutrition and exercise professionals are integral members of the health care team. Expanding research by private and government agencies focusing on the role of nutrition and physical activity in health, growth, and aging has created a demand for graduates at the B.S., M.S., and Ph.D. levels who have a background and interest in laboratory and experimental methods in nutrition, foods and exercise science. The current interest in physical performance in our society has broadened the opportunities for combining expertise in nutrition with exercise and fitness for those with skills in counseling and entrepreneurship. Individuals with a background in food and nutrition are needed to help solve the problems of world hunger and food shortages, and the accompanying loss of human potential.

There are two options from which an undergraduate student majoring in human nutrition, foods and exercise may choose: Dietetics or Science of Food, Nutrition and Exercise.

The department participates in the University's Honors Program (see "[Academics](#)" in this catalog).

The Department of Human Nutrition, Foods, and Exercise at Virginia Tech offers Master's and Doctoral degrees in three specialized areas as they relate to nutrition, physical activity, and health. Graduate students may earn a M.S. or a Ph.D. with an emphasis in Molecular and Cellular Science, Clinical Physiology and Metabolism, or Behavioral and Community Science.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Dietetics

### Consult: Heather K. Cox

The undergraduate Dietetics option, known as the Didactic Program in Dietetics (DPD), leads to a Bachelor of Science degree in Human Nutrition, Foods and Exercise. The dietetics option fulfills all academic course requirements for a Didactic Program in Dietetics according to the Standards of Education per the Accreditation Council for Education in Nutrition and Dietetics (ACEND). ACEND is the accrediting arm of the Academy of Nutrition and Dietetics. Following completion of the B.S. degree, a student has earned an ACEND Verification Statement. A student must then complete a supervised practice program (Dietetic Internship) to be eligible for the Registration Examination (RD) for Dietitians. The supervised practice requirement can be met through any ACEND accredited dietetic internship. Graduates with the B.S. in Dietetics are eligible to apply for the department's, or other, accredited Dietetic Internships.

Registered Dietitians work in a variety of work settings. The dietetics program prepares you to assume a professional role in health care, research, the business environment or to pursue graduate studies. The dietetics program ultimately prepares you to assume a professional role in a health care, research, or

business setting or to go on to graduate school. Clinical dietitians in hospitals and out-patient clinics provide care to individuals with disease-related nutritional problems. Community dietitians may work in health clubs specializing in sports nutrition, in work site wellness programs, or in community programs serving mothers and children, low-income families, or elderly people. Others work for food companies dealing with consumer questions about the nutrient content of food products, or with companies manufacturing nutritional supplements or other medical or health products. Administrative Dietitians with management or business interests find positions in food service management in health care facilities, work site, college, or university food service, or hotels and resorts. Registered Dietitians counsel people of all ages, cultural and ethnic backgrounds, and levels of education.

Students in the Dietetics option must maintain an overall GPA of 3.0 to remain in this option. Students who want to change their major into the Dietetics option with HNFE must have an overall GPA of 3.0. Please see the Satisfactory Progress section for additional requirements.

## Science of Food, Nutrition, and Exercise

### Consult: Renee Eaton

Upon completion of this option a student is well prepared for graduate work in any area of nutrition, exercise physiology or related sciences. This option also meets most admission requirements for medical, dental, physical therapy, pharmacy, physician assistant, athletic training and other health professions programs. This option allows students flexibility to tailor the degree toward long term goals which may lead to employment opportunities in research and development with a company manufacturing nutritional, health and exercise, or medical products, in the food industry in food product testing or quality control, in the health and fitness industry, or in a position related to clinical exercise physiology. Students in this option gain knowledge, skills, and abilities specified by the American College of Sports Medicine for certification as a Certified Health Fitness Specialist. With the growing attention to the role of nutrition and exercise in health promotion and disease prevention, this option is especially appropriate for the student preparing for a career in medicine, physical therapy, or a related health field. The majority of students in the Science of Food, Nutrition and Exercise option plan to attend graduate or professional school.

Students in the SFNE option do not meet the ACEND requirements for a degree in dietetics and therefore do not earn a Verification Statement. Students may choose to earn both the Dietetics and SFNE options in the department.

## Satisfactory Progress

An HNFE student will be considered to have made satisfactory progress toward the degree when he/she has successfully completed:

- In-major GPA  $\hat{\geq}$  2.5 or higher.
- Overall GPA  $\hat{\geq}$  3.0 or higher (Dietetics option) or  $\hat{\geq}$  2.5 or higher (SNFE option)
- Grade of C or better in HNFE 1004, CHEM 1035, CHEM 1036 and CHEM 2535 or 2514.
- These courses must be completed by the time the student has attempted 72 hours:
  - BIOL 1105-1106 or equivalent
  - CHEM 1035-1036 or equivalent
  - CHEM 2535 or 2514
  - HNFE 1004

If a student wishes to double major (or double option) he/she will need to have a **GPA at or above 3.0**.

Students not meeting Satisfactory Progress will have one probationary semester in which to resolve their standing.

**Restricted Major status:** Current Virginia Tech students who wish to change majors into HNFE (or add

as a 2nd major) will be required to have an overall GPA at or above 2.5 (3.0 for Dietetics and double major or double option), have completed CHEM 1035 and CHEM 1036 with grades of C or higher, and create a plan of study that demonstrates how the student will attain Satisfactory Progress in regards to coursework. The GPA threshold of 2.5 (3.0 for Dietetics option) will stand for all students regardless of transfer status. Satisfactory progress towards degree is enforced.

## Undergraduate Course Descriptions (HNFE)

### 1004: FOODS, NUTRITION AND EXERCISE

Scientific information applied to current concerns in foods, nutrition and exercise as it affects the nutritional health well-being of humans. (3H,3C) I,II.

### 1114: ORIENTATION TO HNFE

An introduction to the academic and career planning for students in the Human Nutrition, Foods & Exercise major. (1H,1C)

### 1214: TOPICS IN LIFETIME ACTIVITIES

Participation in physical activity, fitness assessment, motor skill development. Awareness and development of the physical, spiritual, emotional, social, and intellectual components of wellness. Application of healthy lifestyle choices for improved quality of life. May be repeated with varying content, for a maximum of 6 credits. Pass/Fail Only Pass/Fail only. (3L,1C)

### 1264: RACQUETBALL

This course will provide basic instruction in the fundamentals of racquetball. Pass/Fail only. (3L,1C)

### 1804: PRINCIPLES OF SPORT SCIENCE

Introduction to the principal concepts of improving human physical capacity through sport, exercise training and diet. Emphasis on critical thinking and evidence-based decision making in describing the limits to human performance, responses, adaptations, and health benefits of exercise. (3H,3C)

### 2004: PROFESSIONAL DIETETICS

Introduction to the profession of dietetics with emphasis on competencies, preparation, and responsibilities associated with dietetic practice. Overview of the structure of The American Dietetic Association (ADA) and its relationship to the dietetic professional. Discussion of current professional concerns. Co: 2014. (1H,1C) II.

### 2014: NUTRITION ACROSS THE LIFE SPAN

Nutritional requirements and related health concerns of pregnant and lactating women, infants, children, adults and the elderly are studied in relation to the physiological and metabolic aspects of pregnancy, lactation, growth and development, maintenance of health, prevention of disease, and aging. 1 year of biology or chemistry required. CHEM 1056 may be substituted for co-requisite CHEM 1036. Pre: 1004, (CHEM 1035 or CHEM 1055). Co: CHEM 1036. (3H,3C)

### 2014H: NUTRITION ACROSS THE LIFE SPAN

Honors section Pre: 1004, CHEM 1035, CHEM 1036. (3H,3C)

### 2204: MEDICAL TERMINOLOGY

Structure, pronunciation, and use of medical terms; anatomical structures and body systems; terms used in pathology, testing, diagnosis, surgery, pharmacology and treatment. Pre: (BIOL 1005 or BIOL 1105 or BIOL 1205H), (BIOL 1006 or BIOL 1106 or BIOL 1206H) or ISC 2106. (3H,3C)

### 2224: FOOD SELECTION AND PREPARATION LABORATORY

Principles of food preparation and the effect on food quality determined by objective and sensory evaluation. Food choices at the market and consumer consumption and utilization. Pre: (CHEM 1036 or CHEM 1056), HNFE 1004. Co: 2234. (3L,1C) I,II.

### 2234: FOOD SELECTION AND PREPARATION

Principles of the selection and preparation of foods with emphasis on the preparation and the effect on

flavor, texture, and nutritive properties of food. Pre: (CHEM 1035 or CHEM 1055), (CHEM 1036 or CHEM 1056), HNFE 1004. Co: 2224. (2H,2C) I,II.

#### 2254: EXERCISE LEADERSHIP - GROUP FITNESS INSTRUCTOR

Review of the physiological and behavioral concepts and practical skills required to be an effective group fitness instructor for the general population as well as special audiences. Training and certification for Cardiopulmonary Resuscitation and Automated External Fibrillation Certification- CPR and AED is provided. Prepares students to successfully complete the American Council on Exercise Group Fitness Instructor National Certification Exam. Pass/Fail only. (2H,2C)

#### 2264: EXERCISE LEADERSHIP- PERSONAL TRAINER

Review of the physiological and behavioral concepts and practical skills required to be an effective personal trainer, for the general population as well as special audiences. Training and certification for Cardiopulmonary Resuscitation and Automated External Fibrillation Certification- CPR and AED is provided. Prepares students to successfully complete the American Council on Exercise Personal Trainer National Certification Exam. Pass/Fail only. (2H,2C)

#### 2334: INTRODUCTION TO INTEGRATIVE HEALTH

Introduction to the principles of integrative health that promote health and well-being. Examination of the person-centered integrative health treatment methods including holistic stress management, the human spirit, communication, energy healing, elements of meditation, healing environments, Chinese medicine, Ayurvedic medicine, voice work, nutrition, therapeutic massage and bodywork, and healing effects of physical activity. Review of scientific evidence of integrative treatments. (3H,3C)

#### 2544 (FST 2544): FUNCTIONAL FOODS FOR HEALTH

Introduction to functional foods (foods with additional value beyond basic nutrition) including development of functional foods, novel sources, and traditional foods with value-added health benefit; regulatory issues; and media messages. (3H,3C)

#### 2664: BEHAVIORAL NUTRITION & PHYSICAL ACTIVITY

Epidemiological evidence of the benefits of healthful eating and physical activity. Interactions between individuals, the physical/social environment, interpersonal, and intrapersonal determinants of a healthful diet and regular physical activity. Theories underlying individual behavior change and promising approaches for the promotion of healthful eating and physical activity. (3H,3C)

#### 2774: TOPICS IN HNFE

A variable-content course. Explores significant contemporary topics in the areas of nutrition, foods, exercise and health. May be repeated for up to six credits. Variable credit course. Pre: 1004.

#### 2804: EXERCISE AND HEALTH

Introduction to the foundations of exercise science as applied to healthy living, and the concept of exercise as medicine. Fundamentals of health appraisal, foundations of fitness training principles and prescription; nutrition and energy cost, and application of exercise prescription for disease prevention and treatment. Pre: 1004. (3H,3C)

#### 2824: PREVENTION AND CARE OF ATHLETIC INJURIES

An introduction to the techniques and principles of athletic training. (1H,3L,2C) I,II.

#### 2964: FIELD WORK/PRACTICUM

Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3014: FOOD, NUTRITION AND WELLNESS STUDY TOUR

Study of emerging career opportunities in industry, government, and other nonprofit agencies, health care,

consumer education, and research for students in foods, nutrition or exercise science. Special emphasis on program or product development, evaluation, and marketing as related to a target consumer group. Seminars on campus and at prearranged locations during the two day tour. Junior standing or permission; HNFE majors only. II. (1H,1C)

#### 3024: SCIENCE OF FOOD PREP LAB

Application of the principles of food science and food preparation techniques related to health promotion, disease prevention, and disease management. Selection, production, and evaluation of foods and beverages. Emphasis on experimentation illustrating chemical and physical reactions, sensory and physical properties, nutrient manipulation, cooking applications, and functions of foods. Pre: 1004, CHEM 1036, FST 2014. (1H,3L,2C)

#### 3025-3026: METABOLIC NUTRITION

Study of bioenergetics and carbohydrates, lipids, proteins, vitamins and minerals with emphasis on sources, interrelationships and factors affecting utilization and metabolism. The effects of macronutrient and micronutrient intakes related to several metabolic states diseases will be examined. Pre: BMSP 2136, (HNFE 2014 or HNFE 2014H), (BCHM 2024 or BCHM 3114 or BCHM 4115) for 3025; 3025 for 3026. (3H,3C)

#### 3034: METHODS OF HUMAN HEALTH ASSESSMENT

Evidence-based practice in areas of human health assessment including: anthropometric measurements, vital signs, body composition, aerobic capacity, muscular strength, energy requirements, and health behaviors. Comparison and analysis of assessment methods. Pre: 1004, 2014, BMSP 2136. (1H,3L,2C)

#### 3114: FOODSERVICE AND MEAL MANAGEMENT

Foodservice and meal management for the dietetics professional. Emphasis is placed on understanding food procurement, production, distribution, and marketing in a safe and well managed operation. I Pre: 2234, 2224. (3H,3L,4C)

#### 3224: COMMUNICATING WITH FOOD

Development of oral and written communication skills to communicate food and nutrition information to diverse populations. II Pre: 2014 or 2014H, 2234, 2224. (2H,3L,3C)

#### 3634: EPIDEMIOLOGIC CONCEPTS OF HEALTH AND DISEASE

Designed to give students in the health sciences a basic understanding of the modern concepts regarding health and disease as well as skills in organizing epidemiological data, disease investigation and surveillance. Includes a survey of terms, concepts, and principles pertinent to epidemiology. Lifestyles of populations and the relationships between lifestyles and health status are studied. (3H,3C) II.

#### 3804: EXERCISE PHYSIOLOGY

Effects of exercise on physiology: neuromuscular, metabolic, cardiopulmonary. Scientific basis of physical training. I Pre: (BIOL 2405, BIOL 2406) or (BMSP 2135, BMSP 2136). (3H,3C)

#### 3824: KINESIOLOGY

The anatomical and biomechanical basis of human motion, with applications for motor skill acquisition, and development and rehabilitative exercises. I Pre: (BIOL 2405, BIOL 2406) or (BMSP 2135, BMSP 2136), (PHYS 2205 or PHYS 2305). (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4004: SEMINAR IN HNFE: WRITING AND DISCOURSE IN THE MAJOR

Focused review of relevant and current literature in selected areas of food, nutrition and exercise. Develop practical strategies for finding research articles on specific topics utilizing a variety of search tools (e.g., library, on-line search engines, etc.). Develop analytical skills to critically assess the significance of published research data. Develop competence in written and verbal presentation of current

research in formats suitable for a scientific or a lay audience. Pre: COMM 2004 or ALCE 3634. Co: 3025. (3H,3C)

#### 4024: EMERGING ISSUES IN DIETETICS

Investigation of emerging dietetics topics including professional development, new technologies, current legislative issues, and promising evidence-based practice strategies. Integration of knowledge from previous courses to support quality dietetics practice will be emphasized. Pre: 3026. Co: 4125. (1H,1C)

#### 4125-4126: MEDICAL NUTRITION THERAPY

Study of nutritional diagnostic, therapeutic and counseling services provided by a registered dietitian. 4125: Emphasis on the relationship between principles of nutritional care and the medical treatment of individuals with selected diseases or clinical problems. 4126: Integration of knowledge of pathophysiology, biochemical, and clinical parameters, medical treatment and nutrition therapy for patients with selected clinical problems/disease states. 4125: I. 4126: II Pre: 2004, 3026 for 4125; 4125 for 4126. Co: 3034 for 4125. (3H,3C)

#### 4134: EXPERIENTIAL APPROACH TO NUTRITIONAL THERAPY

Use of didactic and experiential methods to learn and apply theories of behavior change in diverse nutrition counseling situations. Pre: Instructor approval. I Pre: 4644. Co: 4125. (2H,2C)

#### 4174: NUTRITION AND PHYSICAL PERFORMANCE

Nutritional requirements for the wellbeing and optimal performance of athletes. Methods of assessment and modification of diet, performance, and body composition in athletes. Evaluation of dietary ergogenic aids and supplements for performance and body composition. Pre: 2804. Co: 3025. (3H,3C)

#### 4224: ALTERNATIVE AND COMPLEMENTARY NUTRITION THERAPIES

Critical evaluation of health claims, mechanisms of action, and research literature for a wide variety of alternative nutrition therapies used for disease prevention and treatment. Practical application of knowledge through completion of problem-based learning projects. Pre: (BIOL 1005 or BIOL 1105 or BIOL 1205H), (BIOL 1006 or BIOL 1106 or BIOL 1206H), (CHEM 1036 or CHEM 1056). (2H,2C)

#### 4254: EXPERIMENTAL FOODS

Experimental study of the functions of ingredients and factors affecting food quality with emphasis on an independent project. Pre: 3234. (1H,3L,2C) II.

#### 4624: COMMUNITY NUTRITION

The application of nutrition principles to an analysis of current applied nutrition programs and a study of the political and legislative processes affecting the practice of dietetics. I Pre: (2014 or 2014H), 3026. (3H,3C)

#### 4634: SOCIO-CULTURAL FOOD SYSTEMS

Study of social, cultural, and economic aspects of food systems, using quantitative and qualitative methods to assess nutritional status. I Pre: 1004, SOC 3004. (2H,2L,3C)

#### 4644: HEALTH COUNSELING

Roles, responsibilities, and limitations of the professional health educator in health counseling, guidance and referral, health needs assessment, dynamics of health counseling interaction, and selected counseling techniques such as crisis intervention and value clarification. Junior standing required. (3H,3C) II.

#### 4645-4646: APPLICATIONS IN NUTRITION COUNSELING

4645: Experiential methods to apply theories of behavior change to promote nutrition and health changes. Learn and apply nutrition care process using evidence-based knowledge through providing client-centered counseling to individuals. Understanding of contemporary issues related to behavior change and emerging issues through review of lay and professional literature. 4646: Advance nutrition counseling skills through work with more diverse clients. Learn and apply quality improvement skills to enhance nutrition counseling service. Identify information on emerging issues and apply appropriately in counseling setting. Pre: 4644 for 4645; 4645 for 4646. Co: 4125 for 4645. (2H,2C)



#### 4774: ADVANCED CONTEMPORARY TOPICS IN HNFE

A variable-content course. Explores advanced topics in the areas of nutrition, foods, exercise or health using higher- order thinking and problem-solving skills. Qualitatively and quantitatively assess current facts supported by scientific literature, as well as controversial issues with conflicting data. May be repeated for a maximum of six credits. Junior Standing. Variable credit course. Pre: 2014.

#### 4834: APPLICATIONS IN CLINICAL EXERCISE

Supervised experience with the Therapeutic Exercise and Community Health Center. Direct Involvement with rehabilitative and preventive exercise and lifestyle programming for cardio-vascular, musculo-skeletal, and other conditions. Exercise leadership, case management, and daily operations. Included seminars, lab experience, and individual meetings with participants and supervisors, related projects. X-grade allowed. Pre: 3874. (9L,3C)

#### 4844: EXERCISE AND NEUROMUSCULAR PERFORMANCE

Functional properties of the neuromuscular system. Emphasis placed on the acute and chronic responses of muscle in exercise, rehabilitation and the factors which determine human performance. Special emphasis on the molecular biological factors responsible for skeletal muscle development and differentiation, as well as adaptation to training and disease states, including activation of signal cascades responsible for the changes in muscle performance. Pre: 3804. (3H,3C) II.

#### 4854: INTERNSHIP IN EXERCISE SCIENCE AND HEALTH PROMOTION

Capstone internship experience in the fields of exercise science and/or health promotion. The student will be immersed in the day-to-day challenges and responsibilities of a practicing health-fitness professional. The 45 contact hours per credit will involve work experience in some aspect of exercise science and/or health promotion. Senior standing and Exercise and Health Promotion majors only. May be repeated for maximum 3 credits. Pass/Fail only. Variable credit course. Pre: 4834.

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Horticulture

### Overview

[Landscape Contracting Major](#)

[Environmental Horticulture Major](#)

[Satisfactory Progress](#)

[Undergraduate Course Descriptions \(HORT\)](#)

**Head:** J. Roger Harris

**Professors:** E. Beers, R. Harris, J. Latimer, A. Niemiera, R. Veilleux, G. Welbaum, and T. Wolf

**Associate Professors:** S. Clark, S. Day, R. McDuffie, H. Scoggins, M. Williams, and B. Zhao

**Assistant Professors:** R. Arancibia, A. Bombarely Gomez, M. O'Rourke, J. Owen, and J. Samtani

**Adjunct Professors:** J. Atland, M. Chaungsheng, K. Da, Y. Dan, B. Flinn, Z. Liu, S. Lowman, and S. Zhang

**Instructor:** A. Hessler, B. Leshyn, and L. Taylor

**A P Faculty Professional:** D. Close, J. Freeborn, S. Gugercin, S. Huckestein, L. Fox, A. Straw, and A. Vallotton

**Undergrad Program Director:** A. Niemiera

**Undergrad Program Coordinator:** M. Wood

Web: [www.hort.vt.edu](http://www.hort.vt.edu)

## Overview

Horticulture is plant science that includes the study of plant growth and plant interactions with the environment (soil, air, water) to improve human life through the cultivation of crops and the maintenance of a sustainable environment. **Horticulture is unique as a scientific field of study in that it often**

**utilizes artistic expression to aid the design of human landscapes and to restore natural environments.** At its core it is an environmental science that recognizes that humans are dependent on their environment for sustenance and well-being that has developed as a field of study that recognizes humans are philosophically and artistically linked to nature through millions of years of human evolution.

Virginia Tech's Department of Horticulture offers graduate and undergraduate degrees in a range of applied and basic environmental plant science topics, from plant-soil interactions, biotechnology, landscape design, sustainable urban landscaping, urban forestry, crop production, and plant breeding. Our department is committed to engaging students in service and learning projects in the local community. To read more about our Engaged Department Award, <http://www.hort.vt.edu/newsCSECP.html>.

## Landscape Contracting Major

Students learn to design, build, and manage beautiful and functional landscapes using science-based practices that improve the living environment and contribute to environmental sustainability.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Environmental Horticulture Major

Experience the creativity and rewards of the many facets of horticulture. Students can specialize in producing floriculture and nursery plants, growing sustainable fruits and vegetables, landscape design and management, and other areas of plant science.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

By the end of the academic year in which the student has attempted 72 hours (including transfer, advanced placement, advanced standing and credit by exam), "satisfactory progress" toward the B.S.

degree will include the following minimum criteria:

- having a grade point average of 2.0, overall and in-major
- passing at least 24 semester credits that apply to the Curriculum for Liberal Education
- passing the following:
  - MATH 1014 and 1025
  - CHEM 1035 and 1036
  - HORT 2224, 2234 or 2244
  - 6 credits additional HORT courses
  - 6 credits from CSES 3114 or 3134, ENT 4254, PPWS 4104

## Undergraduate Course Descriptions (HORT)

### 2134 (FREC 2134): PLANTS AND GREENSPACES IN URBAN COMMUNITIES

Modern concepts of sustainability changing plant use in urban settings. Fundamentals of urban horticulture and urban ecosystems. Philosophy of sustainability, urban forestry, urban wildlife, sustainable and community-supported agriculture, and innovations merging plant and ecosystem functions with building and site engineering. Multi-disciplinary emphasis in individual, community, regional, and global scales. (3H,3C)

### 2144: INDOOR PLANTS

Basic horticultural principles, identification and cultural criteria applicable to foliage and flowering plants grown indoors. Specific plant groups discussed include ferns, cacti and succulents, and carnivorous plants, among many others. Non-majors only. (3H,3C)

### 2154 (SPAN 2154): SPANISH FOR THE GREEN INDUSTRY

Dialogue-based language course focusing on the vocabulary and grammatical structures pertaining to Green and Agricultural Industry jobs. Includes vocabulary and context specific to jobs and workers in greenhouse, nursery, turf and landscape environments. Spanish culture is included throughout the course along with grammar and structure. Prior study in Spanish is helpful but not required. I, II. (3H,3C)

### 2164: FLORAL DESIGN

Principles and methods in floral art through designs for home and public environments. (2H,3L,3C)

### 2184: PLANTS PLACES CULTURE GLOBALLY

The impact of worldwide production and trade in fruits, vegetables, and ornamental plants (horticultural commodities) on cultures, economies, politics, environment, science, and technology. Globalization fundamentals, horticultural trade aspects, and individual commodity case studies illustrate inextricable interactions between horticultural crops, places, and people. (3H,3C)

### 2224: HORTICULTURE SCIENCE AND INDUSTRY

Survey course of horticultural crops (fruits, vegetables, ornamentals) and enterprises. Includes plant science and business aspects of horticultural production and service industries, and introduces related issues and emerging technologies such as work force characteristics, organic production, and biotechnology. I. (2H,2C)

### 2234: ENVIRONMENTAL FACTORS IN HORTICULTURE

Principles and practices in managing environmental factors - temperature, water, light, atmospheric gases and pollutants, and soil and minerals - that influence growth and production of horticultural plants. (3H,3C)

### 2244: PLANT PROPAGATION

Principles and practices of plant propagation by sexual and asexual methods. (2H,2L,3C)

### 2304 (BIOL 2304): PLANT BIOLOGY

Introductory botany. Form, growth, function, reproduction, and ecological adaptations of major groups of plants. Pre: BIOL 1105, BIOL 1106. (3H,3C)

#### 2554 (FREC 2254): ARBORICULTURE FIELD SKILLS

Field observation, discussion, and practice of skills employed in the management of urban landscape trees. Hands-on experience with tree pruning, removal, pest control, fertilization, cabling/bracing, lightning protection, and climbing. Emphasis on arborist safety, professional ethics, and best management practices. Guest instruction provided in part by professionals working in the tree care industry. Pass/Fail only. (3L,1C)

#### 2834: SUSTAINABLE AGRICULTURE PRACTICUM

Hands-on training in sustainable agricultural production at a student-operated vegetable and fruit farm. Participation in tasks required in managing a diversified sustainable horticulture operation, including planting, pest management, irrigation, and post-harvest handling. Discussion of soil fertility, planning, efficiency, food safety and community food systems. May be repeated with different content, for a maximum of 6 credits. (1H,6L,3C)

#### 2964: FIELD STUDY

Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3114 (FST 3114): WINES AND VINES

Principles and standard practices of wine grape production, processing, and sensory evaluation for students with a professional interest in premium table wines. Junior standing and instructor consent required. (2H,2L,3C)

#### 3325-3326: WOODY LANDSCAPE PLANTS

Functions, growing requirements, hardiness, problems, and methods of identification of landscape plant materials. 3325: Commonly available woody landscape plants. 3326: Native and rare woody landscape plants. (2H,3L,3C)

#### 3345,3346: HERBACEOUS LANDSCAPE PLANTS

Identification, growing requirements, culture, landscape use, flowering and dormancy physiology, and unique propagation of native and non-native herbaceous plants for temperate environments. 3345: Summer and fall-flowering ornamental annuals and perennials; cultivated wildflower, wetland, and aquatic systems. 3346: Winter and spring-flowering species and related herbaceous foliage plants. Junior standing required. Pre: 2244. (1H,3L,2C)

#### 3354 (FREC 3354): URBAN FORESTRY AND ARBORICULTURE

Biology, ecology, and management of trees and forested green space in urban and urban-rural interface environments. Life-cycle management of landscape trees, including selection and planting, cultivation and preservation, and utilization and recycling. Urban forest planning, site evaluation, diagnostics, and risk management are emphasized. Pre: (FOR 2314 or FREC 2314 or BIOL 2304 or HORT 2304), (FOR 2324 or FREC 2324 or HORT 3325 or HORT 3326). (3H,3C)

#### 3444 (CSES 3444): WORLD CROPS AND SYSTEMS

An introduction to world crops, their primary regions of production, the factors that determine where they are grown, and their economic importance, and how they are used in the human diet. Describes the various factors that can be managed to improve crop yields. Examines present and potential systems of farming for improved crop production in the major climatic and soil ecosystems of the world. Provides an opportunity to taste foods made in traditional and non-traditional ways from the crops hence from field to fork. Junior standing required. (2H,3L,3C)

#### 3544: LANDSCAPE CONSTRUCTION

Survey of landscape construction materials and methods. Concentration on small scale and residential applications, innovative uses, and cost estimates. (1H,3L,2C)

#### 3584: LANDSCAPE CONTRACTING PRACTICUM

The development of practical skills in landscape contracting. The course will rotate between design and installation of water gardens, landscape irrigation systems, landscape lighting or other pertinent topics on consecutive years. The course can be repeated for exposure to specific subjects to maximum of 3 credits. Junior standing required. Pass/Fail only. Pre: 2224, 2234. (3L,1C)

#### 3644: LANDSCAPE ESTABLISHMENT AND MANAGEMENT

Principles and practices of the establishment and management of sustainable landscapes including site assessment, soil rehabilitation, plant establishment, pruning, irrigation, and maintenance. Emphasis is on hands-on approaches to achieving sustainable landscapes that protect and enhance the environment. Pre: 2234 or 3325 or 2134 or FOR 2324 or FREC 2324. (2H,3L,3C)

#### 3664: HARDSCAPE MATERIALS AND INSTALLATION

Non-plant portions of landscape construction such as rock walls, paver floors, arbors, and water gardens. The course covers the materials, construction methods, and business aspects required for hardscape construction. Pre: 2224. (6L,2C)

#### 4004: HORTICULTURE SEMINAR

Assessment of fundamental horticultural skills developed through academics and employment. Includes career placement preparation and problem solving through research and production project design and implementation using a team approach. Junior standing required. (1H,1C)

#### 4205,4206: PUBLIC GARDENS MAINTENANCE AND MANAGEMENT

4205: Principles and practices of winter annuals and spring blooming bulb production and installation; water garden cultivation and systems maintenance; fall fertilization programming; vegetative waste management; information dissemination and communication methods for public outreach including education, interpretive programs, and fundraising. 4206: Principles and practices of pruning, summer annual production; soil amendment and protection; plant collections/accessions curation and database management; personnel and financial management issues unique to public gardens. Pre: Junior standing required. Pre: (3325, 3326, 3345), (3346 or 3644). (3L,1C)

#### 4324: GREENHOUSE MANAGEMENT

For persons who intend to manage or advise those managing commercial or institutional greenhouses. Includes greenhouse construction, environmental controls, disease/insect identification and management, control of plant growth, root-zone management, and marketing and management principles specific to greenhouse operations. Pre: Coursework or experience in plant growth and environmental management required. (3H,3C)

#### 4504: LANDSCAPE CONTRACTING

Capstone course for students entering the landscape contracting industry. Includes contracts, site plan interpretation, cost estimation and bidding, project sequencing, business marketing, irrigation design, and current issues. Emphasis on real-world skills and problem solving. Pre: Senior Standing Required. Pre: 3264, 4004. (1H,3L,2C)

#### 4545-4546: SMALL SCALE AND RESIDENTIAL LANDSCAPE DESIGN

Development of graphic skills with concentration on a variety of media and techniques. Basic theory and principles on design of small scale and residential landscapes with emphasis on spatial composition, user needs, ecology, and uses of plant materials and light construction. Pre: 3325, 3544 for 4545; 3325, 3544, 4545, 4545 for 4546. (2H,6L,4C)

#### 4614: ORNAMENTAL PLANT PRODUCTION AND MARKETING

In-depth production and marketing of woody and herbaceous plants in wholesale nursery and floriculture/greenhouse and related retail outlets. Includes production laboratory. Pre: 2234, 2244, 4324, AAEC 2434. (2H,3L,3C)

#### 4644: SMALL FRUIT PRODUCTION

Propagation, production, and marketing of small fruit crops for the mid-Atlantic region. Emphasis on sustainable practices, market sectors, and health and nutritional benefits. Blueberries, strawberries,

brambles and other crops. Pre: 2234, 2244, AAEC 2434. (3H,3C)

#### 4654: VITICULTURE

Overview of grapevine growth and development, factors affecting yield and grape quality, and regional industry. Vineyard financial considerations, site evaluation, varietal characteristics plus cultural practices of pruning, training, canopy management, fertilization and pest management. Pre: 2234. (3H,3C)

#### 4764: VEGETABLE CROPS

A comprehensive study of major and minor vegetable crops of Virginia, the U.S., and world in relation to production practices, crop development, nutritional value, and quality characteristics. Pre: 2234. (3H,3C)

#### 4784: VEGETABLE SEED PRODUCTION

The study of production agriculture or reproductive biology. Seed production, handling, identification, conditioning, enhancement, packaging, storage, testing, federal standards, and biotechnology. Pre: 4764 or 2244 or equivalent experience in vegetable crops, plant propagation, or plant growth and development. Pre: 4764 or 2244. (2H,2C)

#### 4794: MEDICINAL PLANTS AND HERBS

Comprehensive study of medicinal plants/herbs history, production, processing, lore and documented scientific benefits. Traditional plant medicinal practices of Native Americans, Chinese, Indians, European and African cultures will be contrasted with use of contemporary herbal products. Pre: BIOL 1005 or BIOL 1105. (3H,3C)

#### 4835-4836: ORGANIC VEGETABLE PRODUCTION

Detailed practices in organic vegetable production. Issues in starting organic production, profitability, organic transition strategies and organic certification. Pre: 2254, ALS 3404 for 4835; 4835 for 4836. (2H,2C)

#### 4845-4846: ORGANIC VEGETABLE PRODUCTION LABORATORY

Field experiences, demonstrations, and farm tours complementing 4835 and 4836 lectures. Co: 4835 for 4845; 4836 for 4846. (3L,1C)

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Hospitality and Tourism Management

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[Overview](#)

[Satisfactory Progress](#)

[Undergraduate Course Descriptions \(HTML\)](#)

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**Head:** Nancy Gard McGehee

**Undergraduate Coordinator:** R. Parsons

**Professors:** M. A. Khan, N.G. McGehee, R.R. Perdue, and M. Uysal

**Associate Professors:** V.P. Magnini, M. Singal, and Z. Xiang

**Assistant Professors:** H. Kang, C. Clemenz, and E. Kim

**Associate Professors of Practice:** R. Parsons

**Lecturers:** H. Feiertag and J.E. Sexton

**Adjunct Faculty:** T. Duetsch and L. Bleakley

Web: [www.htm.pamplin.vt.edu](http://www.htm.pamplin.vt.edu)

E-mail: [htmdpt@vt.edu](mailto:htmdpt@vt.edu)





## Overview

The undergraduate program in hospitality and tourism management prepares students for leadership positions in hospitality and tourism, one of the world's largest industries. The department, which is ranked as one of the best in the world, seeks to provide students with a balance of industry-focused educational opportunities with directed work experiences. All students will take through courses in hospitality, finance, food and beverage operations, tourism management, lodging operations, revenue management, and events. Special emphasis is placed on developing analytical, decision-making, leadership and communications skills. The degree requires an industry field study experience.

The curriculum is flexible, allowing students to pursue specific areas of emphasis. Recommended areas include hospitality operations, global tourism experiences, restaurant and food management, meetings and events, and club and resort management. We also offer a dual degree program with Real Estate which prepares students for the field of asset management or hotel brokerage.

The department offers a variety of international programs and study abroad experiences to give students an enhanced understanding of cultural diversity, experience in international business methods, and practical understanding of hotel and restaurant management in other countries. Through industry scholarships and internal fundraising activities, students are able to attend state, regional, and national hospitality and tourism meetings.

The department is strongly committed to the placement of its undergraduate and graduate students. Industry partners participate in on-campus interview sessions. Industry representatives visit the department during fall and spring semesters to interview students for both permanent placement and internships. HTM conducts a career fair each spring semester for companies offering both career and internships opportunities. Major employers recruit HTM graduates at Virginia Tech, including Marriott, Hyatt, Walt Disney World, White Lodging, Hilton, Compass, Four Seasons, Ritz Carlton, B.F. Saul Hotel Division, Interstate Hotels, Crestline Hotels and Resorts, Cvent, Great American Restaurants, and Panera Bread Company. HTM consistently enjoys one of the top job placement rates on campus for its graduates.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree

requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Hospitality and Tourism Management.

Satisfactory progress requirements toward the B.S. in Business can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (HTM)

### 1414: INTRODUCTION TO HOTEL, RESTAURANT, AND INSTITUTIONAL MANAGEMENT

Management in the hospitality industry, its scope, forms of organization, and professional opportunities. (3H,3C)

### 2434: HOSPITALITY SALES

A comprehensive study of the management of the sales function and its role in the overall financial performance of hospitality operations. (3H,3C)

### 2454: TRAVEL & TOURISM MANAGEMENT

Survey of travel and tourism in the United States and abroad with a focus on terminology, demographics, economic, socio-cultural and environmental impacts of tourism and travel, and the industry's management issues in a global context. (3H,3C)

### 2464: INTRODUCTION TO SERVICE

An overview of the service industry, history, current status, and future trends. Emphasizes the unique characteristics and operations of service organizations. (3H,3C)

### 2474: INTRODUCTION TO MEETINGS & CONVENTION MANAGEMENT

A study of the meetings and convention industry. Focus on the components and processes involved in developing and conducting meetings and conventions. (3H,3C)

### 2514: CATERING MANAGEMENT

Introduces students to various venues in which catering services can be offered, and presents an overview of the functions, processes, and controls found in successful catering management and operations; emphasis is placed on the sales/marketing aspects of the business. (3H,3C)

### 2954: HOSPITALITY AND TOURISM STUDY ABROAD

This course provides students with an international hospitality and tourism management business experience. It is only offered as part of a program outside the United States. Students will learn from the structured educational experience developed by the faculty directing the study abroad program. This course can be taken twice for a maximum of six credit hours. Sophomore standing and a minimum GPA of 3.0 required. (3H,3C)

### 2964: FIELD STUDY

X-grade allowed. (3H,3C)

**2974: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3044: PRIVATE CLUB MANAGEMENT**

Develop an understanding of the private club sector of the hospitality industry. Topic areas are divided into club fundamentals, revenue-generating operations within clubs and support functions/departments of club operations. Junior standing as well as background courses in basic financial management are suggested. (3H,3C)

**3114: SPECIAL TOPICS IN HOSPITALITY AND TOURISM STUDIES**

Variable content that addresses timely and complex issues of the hospitality and tourism industry from a variety of disciplines or intellectual domains. This course provides HTM students with knowledge that is not formally part of the curriculum. Students will learn from the structured learning experience and knowledge domain developed by the faculty offering the course. May be repeated up to five times, for a maximum of 15 credit hours with different content. Pre: 1414 or 2454 or 2464. (3H,3C)

**3244: FRANCHISING SERVICE INDUSTRIES**

Theory and practice of franchising as a form of business ownership and a vehicle for entrepreneurship. Contemporary issues related to franchising in different segments of the services industries including hospitality and tourism. Legal aspects, financial viability, ethical issues, and agency relationships in franchising. Franchise concept development, franchisor-franchisee relationship, franchise agreements, family business, minority franchising, and international franchising. Junior standing required. (3H,3C)

**3414: Food Preparation, Purchasing, and Management**

Food and kitchen safety, hazard analysis, purchasing, recipe development, costing, and volume food preparation, in a commercial kitchen lab experience one day per week along with a two hour per week lecture. Additional fee required. Junior Standing. (2H,5L,4C)

**3444: FINANCIAL MANAGEMENT AND COST CONTROL FOR HOSPITALITY ORGANIZATIONS**

The application of accounting, finance, and cost control principles to hospitality industry organizations. The focus of this course is to provide future food service and lodging organization managers with the ability to handle the unique problems regarding financial analysis and cost control in this industry. Pre: ACIS 2116, ECON 2006. Co: FIN 3104. (3H,3C)

**3454: TOURISM ANALYSIS**

Different aspects of tourism, including origin and destination flow models, tourism destinations and their attractiveness, impacts of tourism, tourist profiles and destination decisions, demand/supply interaction, and barriers to travel are explored and analyzed. (3H,3C)

**3484: SOCIO-CULTURAL IMPACTS OF TOURISM**

A study of both historic and current socio-cultural impacts of tourism on family, community, culture, government, and the environment. The course examines the ways in which tourism has both affected and been affected by modern society worldwide. (3H,3C)

**3524: LODGING MANAGEMENT**

Organization, function, and management of lodging operations. Current issues and management challenges in the lodging industry. Applications of revenue management to lodging systems. Pre-requisite: Junior standing in the Pamplin College of Business. (3H,3C)

**3954: HTM STUDY ABROAD**

This course provides students with an international hospitality and tourism management business experience. Students will be required to apply their knowledge and skills from their Pamplin College of Business core courses within this course. Students will learn from the structured educational experience developed by the faculty directing the study abroad program. Pamplin College of Business majors must

have been approved for upper division course- work. Variable credit course.

#### 4354: INFORMATION TECHNOLOGY AND SOCIAL MEDIA IN HOSPITALITY AND TOURISM

Study of the strategic use of information technology (IT) in today's hospitality and tourism organizations. Study of the most widely used information systems in operation, management, and e-business in hospitality and tourism. Study of social media as a marketing tool for hospitality and tourism businesses. Examine impacts of IT on organizations and the industry as a whole. Pre: MKTG 3104 or MKTG 3104H. (3H,3C)

#### 4414: FOOD AND BEVERAGE MANAGEMENT

Organization, administration, and operation of food service operations. Opportunity is provided for administration of the departmental cafeteria. Additional fee required. X-grade allowed. Pre: 3414. (3H,3C)

#### 4424: EVENTS MANAGEMENT

Management of special events in the hospitality and tourism industry. Students will explore organizational functions necessary for producing special events, as well as analyzing the factors that influence an event's success, such as organizational structure, risk management and the impact of tourism activity. Junior standing in HTM is required. (3H,3C)

#### 4444: WINERY TOURISM

The course focuses on the role of wine and wineries in tourism, wine marketing and management in the hospitality industry, and examines the components of a winery. Students must be 21 years of age due to the inclusion of wine tasting in the course. Additional fee required. (3H,3C)

#### 4454: HOSPITALITY REVENUE MANAGEMENT

Examines lodging and foodservices Revenue Management (RM) issues. Customer-centric approach, explores RM from various traditional academic perspectives, including economics, pricing, forecasting, consumer behavior, accounting, finance, and human resources. Management-oriented, emphasizes practical aspects of decision-making. Applies theoretical concepts through class discussion, group projects and individual assignments. Pre: MKTG 3104 or MKTG 3104H, BIT 2406, ECON 2006. (3H,3C)

#### 4464: HUMAN RESOURCES MANAGEMENT IN THE HOSPITALITY INDUSTRY

An overview of the concepts of human resources management as applied to the specific environments within the hospitality industry. Pre: MGT 3304. (3H,3C)

#### 4484: INTERNATIONAL TOURISM

Survey of global travel and tourism issues, including trends and patterns of global tourism, flow models, constraints and obstacles to international travel, demand for travel and tourism, tourism supply distribution, destination competitiveness, tourist safety and security, international travel and tourism organizations, performance measures. Analysis of sustainable indicators in protected areas and world heritage sites, tourism statistics and trends. Pre: MKTG 3104 or MKTG 3104H. (3H,3C)

#### 4954: STUDY ABROAD

Variable credit course.

#### 4964: FIELD STUDY IN HTM

X-grade allowed. Pre: (3414, 3524) or (3414, 3444) or (3254, 3444). (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Industrial Design

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**Chair:** Ed Dorsa - IDSA

**Associate Professors:** E. Dorsa, W. Green, A. Jensen, and B. Kennedy

**Visiting Instructor:** M. Sullivan

**Adjunct Professor:** R. Reuter

**Professor Emeritus:** R. Kemnitzer

Web: [www.industrialdesign.arch.vt.edu/](http://www.industrialdesign.arch.vt.edu/)

## Overview

As described by the Industrial Designers Society of America, "Industrial Design (ID) is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer.

Industrial designers develop these concepts and specifications through collection, analysis and synthesis of data guided by the special requirements of the users, client and manufacturer. They are trained to prepare clear and concise recommendations through drawings, models and verbal descriptions.

Industrial design services are often provided within the context of cooperative working relationships with other members of a development group. Typical groups include management, marketing, engineering and manufacturing specialists. The industrial designer expresses concepts that embody all relevant design criteria determined by the group.

The industrial designer's unique contribution places emphasis on those aspects of the product or system that relate most directly to human characteristics, needs and interests. This contribution requires specialized understanding of visual, tactile, safety and convenience criteria, with concern for the user. Education and experience in anticipating psychological, physiological and sociological factors that influence and are perceived by the user are essential industrial design resources."

The internationally recognized program at Virginia Tech, fully accredited by the National Association of Schools of Art and Design, prepares individuals to enter this dynamic field through a rigorous curriculum and an experienced, dedicated faculty.

## Program Requirements

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

### Minor in Industrial Design

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for minor requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Urban Affairs and Planning.

Satisfactory progress requirements toward the degree can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (IDS)

### 2015-2016: INDUSTRIAL DESIGN LABORATORY II

Introduction to the discipline of Industrial Design. Emphasis on form generation, including: design theory, problem solving methodologies, conceptualization of ideas, and aesthetic sensibility. Secondary emphasis on skill development in 2 and 3 dimensions: awareness of materials and manufacturing processes, storyboarding, model making, written documentation of design process, and verbal presentation. IDS 2015 is taught in conjunction with IDS 3224: Topics in Design Competencies: Workshop and IDS 2065: Visual Design. Pre: ARCH 1016 for 2015; 2015 for 2016. 2015: (3H,7L,5C) 2016: (3H,9L,6C)

### 2044: HUMAN FACTORS

This course examines human factors as it informs the design process, and as a tool to maximize the physical and psychological aspects of design toward the establishment of a human centered design. Frameworks of industrial design philosophy, research methods, standards and data, human issues, cultural context, and design outcomes. Pre: ARCH 1016. (3H,3C)

#### 2065-2066: DESIGN VISUALIZATION

An introduction to two-dimensional modes of representation. Emphasis is placed on the development of drawing skills to facilitate documentation, analysis and presentation in the design process. Pre: ARCH 1016 for 2065; 2065 for 2066. (2H,2C)

#### 2114: HISTORY AND THEORY OF INDUSTRIAL DESIGN

The aesthetics and useful function of objects of industrial production. This class is based upon the concept that the values, ideals, and aspirations of a culture are expressed in material objects and a thorough knowledge of the history of the profession is essential to understand one's own particular circumstance and time. (3H,3C)

#### 2124: HISTORY AND THEORY OF INDUSTRIAL DESIGN-DESIGNERS

The study of individual designers and how their values, ideals, and aspirations influence the evolution of design. (3H,3C)

#### 2214: IDS STUDIO FOR MINORS

Introduction to the discipline and the critical elements that contribute to the complexity of a work of design. Emphasis on intellectual discipline, skills development, communication of ideas, materials research, and a self-motivated search for critical issues. For registered Industrial Design Minors only. (3H,9L,6C)

#### 2304: COMPUTER AIDED INDUSTRIAL DESIGN

An introduction to computer aided two and three- dimensional design and modeling as applied in industrial design using both solid and surface software modeling techniques. Pre: ARCH 1016. (3H,3C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3015-3016: INDUSTRIAL DESIGN LABORATORY III

Introduction to systematic processes in design. Introduction and application of Human Factors and systematic planning methods in the development of industrial products in the areas of work, education and health. Development of professional presentation skills and methods. Pre: 2016 for 3015; 3015 for 3016. (3H,9L,6C)

#### 3124: MATERIALS AND PROCESSES

Current design processes, materials, manufacturing processes, techniques, and equipment used in the design of products for mass and rapid production. Variety of materials and manufacturing processes available to the industrial designer for mass production impact his/her design process. Emphasis placed on the relationship of processes and equipment, to the environment and the end user. Includes concepts of material science. Practical issues of material selection and application, process selection, and specification. (3H,3C)

#### 3204: TOPICS IN PROFESSIONAL DEVELOPMENT

Issues of practicing in an industrial design professional environment: public speaking, portfolio presentation, client/civic engagement (service learning), interdisciplinary teamwork and leadership in the development process of industrial products. Repeatable with instructor permission. Variable credit and duration. Variable credit course.

#### 3214: IDS SUMMER STUDIO

Design Laboratory for industrial design. Introduction to systematic processes in design. Application of Human Factors and systematic planning methods in the development of industrial products in the areas of work, education and health. Development of professional presentation skills and methods. For industrial design majors only. Faculty permission required. (3H,9L,6C)

#### 3224: TOPICS IN DESIGN COMPETENCIES

Issues of industrial design competencies and expertise required in a professional design environment, for example: software; model making (both hand making and digital rapid prototyping); workshop (wood, metal and plastics); specialized product design areas (packaging, furniture or exhibit design). Repeatable with instructor permission Variable credit and duration. Variable credit course.

#### 3234: TOPICS IN DESIGN THEORY

Issues of industrial design theory required for advancement in a professional design environment, for example: Product Semantics; Design Ethics; EcoDesign/Sustainability; Universal Design. Repeatable with instructor permission. Variable credit and duration. Variable credit course.

#### 3514: DESIGN RESEARCH

The course looks at the question of research and the ongoing exercise of re-definition for designers using examples of current design research corporations. Pre: 2016. (3H,3C)

#### 4015-4016: INDUSTRIAL DESIGN LABORATORY IV

Detailed analysis, research and application of human factors to the design of equipment, work spaces and environments. Design and construction of full scale, interactive models and spaces. Introduction to group activities. Emphasis on the needs, the production and marketing factors of special populations, such as the elderly and disabled. Pre: 3016 for 4015; 4015 for 4016. (3H,9L,6C)

#### 4044: PROFESSIONAL PRACTICE AND ENTREPRENEURSHIP

Focus on assembling multidisciplinary teams to engage in the process of bringing a product to market, building a business around a core competency in design, the structure of a design office, and the development and protections of intellectual property. Pre-requisite: Senior standing or permission of instructor. Pre: 2015. (2H,2C)

#### 4094 (ENGE 4094) (MGT 4094): MANAGING TECH COMMERCIALIZATION

How technology-based innovations, innovations developed through science or engineering expertise, are leveraged from the innovative idea or concepts to successful commercial products. Examines the frames that guide the technology commercialization process and applies these frames by using cross-functional teams to investigate a commercialization project from opportunity scanning to exploitation. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## International Studies

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**Director:** Ioannis Stivachtis

Web: [www.liberalarts.vt.edu/academics/majors-and-minors/international-studies-major.html](http://www.liberalarts.vt.edu/academics/majors-and-minors/international-studies-major.html)

## Overview

The International Studies Program offers four (4) majors, leading to a Bachelor of Arts in International Studies (BAIS):

- Major in International Public Policy (IPPL)
- Major in International Relations (IREL)
- Major in International Studies (IS)
- Major in National Security & Foreign Affairs (NSFA)

Students pursuing these majors are prepared to continue their studies in graduate or law school or immediately apply their skills and knowledge in various professional settings because of the broad applicability of both the theory to which they are exposed and the competencies they develop. Rooted in

a strong liberal arts curriculum, the International Studies Program prepares students to enter careers in government service (Department of State, Department of Defense, Department of Homeland Security, the intelligence community), Foreign Service, Think Tanks, teaching, journalism, international governmental and non-governmental organizations, and private companies.

## Majors

Students may choose to pursue one or more of the four majors offered by the International Studies Program. In this case, no course can double count within or between International Studies-related majors with the exception of IS 1004, IS 2004, IS 2054, IS 2064, IS 2084, IS 3115, IS 3116 and IS 4004.

All students who wish to obtain a major offered by the International Studies Program must complete: 1) the Core Curriculum requirements of the College of Liberal Arts and Human Sciences; 2) the Core Curriculum requirements of the Bachelor of Arts in International Studies (BAIS) degree; and 3) a set of elective courses associated with each of the four majors.

The *International Public Policy (IPPL)* major is designed to help students analyze the choices and challenges that arise in the global economic system and equip them with a better understanding of how states and societies can pursue their economic goals in an environmentally and socially sustainable manner. It emphasizes the role of international organizations in global economy and development as well as helping students to think critically about the globalization's impact on world economy, sustainable development and the fight against global poverty. Its purpose is to relate theory to practice and provide students with a breadth of knowledge and training in the various facets of sustainable international development and the sub-fields of governance and political economy, environment and development, and international public health. It seeks to prepare students for a fast-growing number and variety of careers in the planning, implementation, and evaluation of development programs, working for governments, international organizations, NGOs, and private companies.

The *International Relations (IREL)* major focuses on the analysis of the political, societal, cultural, ethical, and normative aspects of international relations, as well as offering students a rigorous international and comparative perspective on the contemporary global system. It emphasizes a solid grounding in the methods of analysis used in the social sciences and humanities to help students think critically about international phenomena and analyze the choices and challenges that arise in this arena. It seeks to foster creative thinking about complex global problems and produce very competitive graduates and enlightened citizens who would possess the necessary knowledge and skills that would allow them not only to successfully pursue careers in their chosen field but, most importantly, serve their communities and the nation.

The *International Studies (IS)* major offers an opportunity to learn about foreign cultures, religions, languages, economics, and history. The curriculum is interdisciplinary in orientation and is designed to introduce students to a variety of important approaches for understanding the international scene. Whether or not students will pursue careers directly related to world affairs, the understanding gained in this major will provide a much broader perspective of the world and the United States' place in it. This major makes use of courses in economics, geography, foreign languages, history, religion and culture, sociology, and other disciplines.

The *National Security and Foreign Affairs (NSFA)* major offers students expertise and understanding of the broad range of threats to national and global security in the 21st century and equips them with the necessary knowledge and skills that would allow them to successfully pursue careers in diplomacy and international organizations. The National Security and Foreign Affairs (NSFA) major analyzes the role of diplomacy in the management of world affairs and examines in-depth U.S. grand strategy and foreign policy; the current and future global geopolitical environment that affect the U.S. and its interests; the ends, ways, and means that impact the use of military force; the informational issues that contribute to the holistic implementation of strategy, and counterterrorism and homeland security. It is designed to connect theory to practice thereby providing a hands-on, practical approach to the field that would equip students with the tools to analyze threats that challenge U.S. security both at home and abroad.

Please see <http://liberalarts.vt.edu/academics/majors-and-minors/international-studies-major.html> for more information.

## Major Requirements

The curriculum is designed to provide foundational and development courses, major-specific study, and a capstone experience. Students are introduced to concepts early in the undergraduate career, and the curriculum allows them to build knowledge and skills as they work on increasingly complex tasks. They also develop skills in written, spoken, and visual communication across their studies in the major. At the foundational level, students in every major are required to take the same introductory courses. Then students move into one of four majors, and later they come back together in the senior year to work on a capstone experience.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Minor Requirements

The International Studies Program offers four (4) minors:

- Minor in International Public Policy (IPPL)
- Minor in International Relations (IREL)
- Minor in International Studies (IS)
- Minor in National Security & Foreign Affairs (NSFA)

For the 18-hour minor, students enroll in three required courses and choose other three courses from the minor elective list. Please see <http://liberalarts.vt.edu/academics/majors-and-minors/international-studies-major.html> for details.

The minor in *International Public Policy (IPPL)* is designed for students who wish to develop the analytical and leadership skills necessary to formulate and advocate policy on key international issues. It seeks to provide students with a detailed and systematic understanding of how political institutions, processes, and public policies operate in world affairs. The program brings together the academic study of international relations with analysis of public policy formulation and governance beyond the nation-state. The program seeks to prepare students for a fast-growing number and variety of careers in the planning, implementation, and evaluation of development programs, working for governments, international organizations, NGOs, and private companies.

The minor in *International Relations (IREL)* is designed to offer students a rigorous international and comparative perspective on the contemporary global system. It focuses on the changing political and cultural relations within the international system in the modern era, exploring how global, regional, and domestic factors influence relations between actors on the world stage. Students are equipped with both the foundational skills and specific knowledge necessary to analyze the choices and challenges that arise in this arena. The program seeks to provide a hands-on, practical approach to the field that would equip students with the analytic tools, language expertise, and cross-cultural understanding necessary to pursue

successful careers in government, Foreign Service, and international organizations.

The minor in *International Studies (IS)* offers students an interdisciplinary approach to the study of global affairs. The purpose of the program is threefold: first, to supplement the knowledge and skills that students have acquired through their major field of study with knowledge about the global political and economic system and the global forces and processes that shape our daily lives; second, to further students' critical and analytical skills; and third, to create knowledgeable and enlightened citizens and global leaders.

The minor in *National Security and Foreign Affairs (NSFA)* analyzes the role of diplomacy in the management of world affairs and provides a hands-on, practical approach to security analysis that would equip students with the tools to analyze threats that challenge US security both at home and abroad. The program seeks to supplement the knowledge and skills that students have acquired through their major field of study with expertise and understanding of the broad range of threats to national and global security in the 21st century, as well as to equip students with the necessary knowledge and skills that would allow them to successfully pursue careers in diplomacy and international organizations.

## Satisfactory Progress Toward the Degree

University policy requires that students demonstrate their progress toward the degree by meeting minimum requirements.

To proceed satisfactorily toward a degree, a student must complete IS 1004, IS 1034, IS 2004, IS 2054, IS 2064, IS 2084 and Foreign language 2105 & 2106 by the end of the semester in which 60 hours have been attempted; must maintain an overall GPA of at least 2.0 and must maintain an in-major GPA of 2.0.

Students who fall below the standard for either the overall GPA or the in-major GPA will have one semester to regain the required GPA standards. A student who fails to make satisfactory progress toward degree after that semester will be blocked from continuing in the major.

## Freshmen and External Transfers into the International Studies Program

Incoming freshmen and students enrolled at other institutions should follow directions for application as shown on the Admissions website: [www.admiss.vt.edu](http://www.admiss.vt.edu).

## Internal Transfers into the International Studies Program

Students enrolled in other Virginia Tech majors who wish to transfer into the International Studies Program must attend an information session and submit an application.

## Undergraduate Course Descriptions (IS)

### 1004 (PSCI 1004): NATIONS AND NATIONALITIES

Introduction to world and American ethnic and indigenous cultures and to social constructions of human and group identity, nationalism and extreme ethno-nationalism. Music, dance, film, art, ceremonial rituals and other multimedia forms of creative or symbolic expression, supplement readings and lectures. Multidisciplinary exploration of collective conceptions of cultural differences. (3H,3C)

### 1034 (PSCI 1034): INTRODUCTION TO INTERNATIONAL STUDIES AND POLITICAL SCIENCE

Introduces students to the fields of International Studies and Political Science and their respective subfields. Familiarizes students with the undergraduate programs in International Studies and Political Science and emphasizes student preparation for careers in the respective fields. Focuses on inquiry, problem-solving, integration of ideas and experiences with a focus on International Studies and Political Science. Familiarizes students with the basic principles of the research and writing process. (3H,3C)

#### 2004: RESEARCH AND WRITING IN INTERNATIONAL STUDIES

Introduces the research and writing process in the field of International Studies. Addresses topics such as selecting and planning a research project, conceptualizing a research design, gathering and analyzing data, interpreting the results and writing a report. (3H,3C)

#### 2034 (GEOG 2034) (PSCI 2034): GEOGRAPHY OF GLOBAL CONFLICT

Geographical dimensions of global conflicts, international management of conflicts, conflicts of differences, historical, ideological, failed states and resources will be examined. Background to conflicts, current status of conflicts, different points of view in conflict. Topics in the course will change as the geography of global conflict changes. (3H,3C)

#### 2044 (FST 2044) (PSCI 2044): FOOD, WAR AND CONFLICT

Explores the history of food production and processing relative to the commencement or continuation of conflict. Examines why and how wars have been fought over economic policies, food trade and control of food supplies. Examines efforts to protect food and water supplies from intentional contamination and acts of terrorism. Focus on food products and the preservation, processing and distribution technologies that arose from war and conflict. (3H,3C)

#### 2054 (GEOG 2054) (PSCI 2054): INTRODUCTION TO WORLD POLITICS

An introduction to the prevalent methods and theories in the study of world politics. Topics include: historical context of contemporary world politics, global actors and power relations, international conflict and conflict resolution, international systems, interdependence, trade and international law and prospects for global governance. (3H,3C)

#### 2064 (GEOG 2064) (PSCI 2064): THE GLOBAL ECONOMY AND WORLD POLITICS

An introduction to the interaction of politics and economics power and wealth, within the world political economy. Topics include: the international financial system, the dynamics and principles of trade, and the role of transnational firms, as well as issues of environmental protections, sustainable development, and the distribution of wealth and power. (3H,3C)

#### 2084 (PSCI 2084): THEORETICAL APPROACHES TO GLOBAL ORDER

Examines the evolution of the inter-state system and focuses on the political, economic, societal and technological progresses that shape the relations among states and people. Investigates topics such as the role of religion, culture and civilizations in world affairs; the globalization of the European system and the question of human equality; the impact of colonialism and post-colonialism on the question of justice and rights; and the effects of imperialism, capitalism and globalization on world order. (3H,3C)

#### 2134 (GEOG 2134) (PSCI 2134): GEOGRAPHY OF THE GLOBAL ECONOMY

Geographical dimensions of the global economy since World War II. Globalization and the emergence of a new international division of labor. The relative decline of the United States and the growth of Japan, East Asia and the European Union. Changing geographies of foreign direct investment location. Places and regions in geo-economic discourse. Population and resources issues in the early twenty-first century. (3H,3C)

#### 2474 (RLCL 2474): RELIGION AND VIOLENCE

Investigation of the categories of religion and secularity as they apply to war and peace. Analysis of episodes from both past and present in which religion seems to have played a role. Introduction to research skills related to the study of religion and violence, building from theoretical and historical considerations. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

3004 (PSCI 3004): PROFESSIONALISM AND CAREERS IN POLITICAL SCIENCE AND INTERNATIONAL STUDIES

Designed to teach students how to synthesize skills and information learned in their Political Science and International Studies classes. Exploration of various career options, graduate school options, and proper procedures for seeking and applying for employment and graduate school. Introduction to professionalism in the workplace and professional development in the area of political science and international studies. Junior Standing. (3H,3C)

3034 (GEOG 3034) (PSCI 3034): THE CIA: ITS CAPABILITIES IN TODAY'S GEO-POLITICAL WORLD

Role of the discipline of geography in the origins, procedures, and history of CIA. Role of the CIA in providing national intelligence at both strategic and operational levels. Origins and changes to the CIA since WWII. Capabilities to support both policy-makers and national security entities. Case studies illustrating the CIA's operations in different regions of the world. (3H,3C)

3104 (PSCI 3104): SECURITY STUDIES: THEORIES AND CONCEPTS

Introduces the various theoretical approaches to security. Examines key concepts in the field of Security Studies, such as uncertainty, polarity, war, coercion, terrorism, intelligence, genocide, crimes against humanity, ethnic conflict, and human security. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

3114 (PSCI 3114): GLOBAL SECURITY

Explores various theoretical approaches to security and discusses traditional and non-traditional security issues. Focuses on global, international and regional security challenges and examines alternative strategic and tactical solutions for addressing them. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

3115,3116 (PSCI 3115, 3116): SELECTED WORLD PROBLEMS

Selected world problems and how they affect various countries. Each semester, a topic will be chosen. (3H,3C)

3125-3126 (PSCI 3125): INTELLIGENCE AND NATIONAL SECURITY

Introduces students to the field of Intelligence Studies. Focuses on the structure, role and capabilities of the U.S. intelligence community and investigates the relationship between intelligence and national security strategy. Addresses topics pertaining to data collection and intelligence analysis, covert operations and counterintelligence. 3125: Intelligence and National Security. 3126: The Intelligence Process. Pre: 2054 or PSCI 2054 or GEOG 2054 for 3125; 3125 or PSCI 3125 for 3126. (3H,3C)

3134 (PSCI 3134): GLOBAL CONFLICT AND WAR

Focuses on the causes, legal and moral constraints, impacts, and consequences of conflict and war. Explores historical and contemporary cases of conflict and war and investigates the role of state and non-state actors in these conflicts. Examines the impact of technology, religion, culture and identity on the present and future of war. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

3135-3136 (PSCI 3135-3136): STRATEGIES OF MODERN WARFARE

3135: Analyzes the theory and practice of conventional warfare and investigates how strategic thought has influenced and shaped modern warfare. 3136: Examines the theory and practice of irregular warfare and focuses on the theory and practice of counterinsurgency and counterterrorism. Pre: 2054 or PSCI 2054 or GEOG 2054 for 3135; 3135 or PSCI 3135 for 3136. (3H,3C)

3144 (PSCI 3144): GLOBAL GOVERNANCE & PUBLIC POLICY

Examines the norms, institutions, practices and processes developed by the international community to address global problems such as poverty, pandemics, global warming, displaced persons and transnational crime. Utilizes theories of decision- and policy-making and investigates the role of states, international governmental and non-governmental organizations, coalitions and corporations in global public policy-making. Pre: (2054 or PSCI 2054 or GEOG 2054), (IS 2064 or PSCI 2064 or GEOG 2064). (3H,3C)

**3154 (PSCI 3154): TOPICS IN GLOBAL PUBLIC POLICIES**

Examines in depth selected global public policies pertaining to health, energy, environment, development, education, refugees or labor. May be repeated with different content for a maximum of nine (9) credits.

Pre: (2054 or PSCI 2054 or GEOG 2054), (IS 2064 or PSCI 2064 or GEOG 2064). (3H,3C)

**3165,3166 (PSCI 3165, 3166): GLOBAL ECONOMIC GOVERNANCE & POLICY**

3165: International Trade - Focuses on the operations of global and regional international organizations such as the World Trade Organization (WTO), the European Union (EU), the United Nations Conference on Trade and Development (UNCTAD), the United Nations Industrial Organization (UNIDO) and the World Intellectual Property Organization (WIPO) and examines their policies and regulations. 3166: International Finance - Focuses on the operations of global and regional international organizations such as the International Monetary Fund (IMF) and World Bank, the European Union (EU), the Organization for Economic Cooperation and Development (OECD) and examines their policies and regulations. Pre: 2064 or PSCI 2064 or GEOG 2064. (3H,3C)

**3175,3176 (PSCI 3175, 3176): GLOBAL DEVELOPMENT**

3175: The Politics of Development - Examines issues and politics of the developing world and investigates the forces that promote or cut off economic development in low-income countries. Discusses development issues in various world regions. 3176: Economic Development - Emphasizes economic development and focuses on domestic and international policies aiming at addressing poverty in the developing world. Pre: (2054 or PSCI 2054 or GEOG 2054), (IS 2064 or PSCI 2064 or GEOG 2064). (3H,3C)

**3184 (PSCI 3184): HUMAN SECURITY**

Introduces the field of human security and examines the conceptual, theoretical, and methodological issues surrounding it. Identifies the relevant human security actors, explores the tools of human security, and discusses the application of human security. Investigates the implications of human security and discusses its future. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

**3194 (PSCI 3194): NUCLEAR STRATEGY & POLITICS**

Examines the fundamentals of nuclear strategy and investigates the politics associated with the acquisition and proliferation of nuclear weapons. Focuses on nuclear doctrines and policies and explores international efforts associated with nuclear arms control and disarmament. Analyzes the nuclear postures of various nuclear states. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

**3615-3616 (PSCI 3615-3616): INTERNATIONAL RELATIONS**

Structure and development of the modern international system, theories of international policies, international law; international organizations. Pre: 2054 or PSCI 2054 or GEOG 2054 or PSCI 2064 or IS 2064 or GEOG 2064 for 3615; PSCI 2054 or IS 2054 or GEOG 2054 or PSCI 2064 or IS 2064 or GEOG 2064 for 3616. (3H,3C)

**3624 (PSCI 3624): FOREIGN POLICY AND DIPLOMACY**

Focuses on actors, issues, and processes pertaining to foreign policy formulation and implementation. Examines theoretical and historical perspectives on foreign policy analysis. Investigates the national security, foreign policy, and diplomacy nexus. Discusses type of diplomacy and diplomatic methods. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

**3625,3626 (PSCI 3625, 3626): US-RUSSIA FOREIGN POLICIES**

3625: Formulation of American foreign policy; roles of the President; Congress; press; public; and bureaucracy; central themes, issues, and problems of American diplomacy; 3626: Development and operational practices of Russian foreign policy decision-making in the international environment; party and state political institutions; Marxist-Leninist ideology. Pre: PSCI 1024 or PSCI 1024H. (3H,3C)

**3634 (PSCI 3634): HUMAN RIGHTS: GLOBAL ISSUES**

Identification, articulation and clarification of the relationship between human rights and other contemporary international phenomena, issues, events, and processes that affect human rights. Detailed consideration of the diverse traditions and cultural interpretations of human rights. Pre: PSCI 1024 or PSCI 2054 or IS 2054 or GEOG 2054. (3H,3C)

#### 3704 (PSCI 3704): NATIONAL SECURITY STRATEGY

Focuses on the causes of war and the conditions of peace. Examines the logic, levels, and outcomes of strategy and investigates the impact of international law and politics on the use of force. Explores contemporary strategic theory and discusses current issues in grand strategy. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3734 (PSCI 3734): NATIONAL SECURITY

Post-1945 strategic problems, policies, and security commitments of major participants in international politics, especially the United States and Russia; effects of security policies on international and domestic political economies. Pre: PSCI 2054 or IS 2054 or GEOG 2054. (3H,3C)

#### 3735-3736 (PSCI 3735-3736): NATIONAL SECURITY POLICIES

Investigates the purposes, contexts and processes of national security policymaking both in the United States and in other states around the world. 3735: Focuses on Homeland Security. 3736: Focuses on Defense Policy. Pre: 2054 or PSCI 2054 or GEOG 2054 for 3735; 3735 or PSCI 3735 for 3736. (3H,3C)

#### 3794 (PSCI 3794): TERRORISM AND COUNTERTERRORISM

Examines approaches to the categorization and causes of terrorism and discusses national and regional understandings of terrorism. Explores official and popular understandings of terrorism over time and across regions and investigates how social actors legitimate their use of violence. Focuses on the development of useful counterterrorism policies and utilizes case studies in terrorism and counterterrorism to emphasize the link between theory and practice. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3944: INTERNATIONAL ENROLLMENT

Participation in an approved study abroad program without direct supervision of the Va Tech faculty but with required enrollment in an approved program of study in a foreign university. (0C)

#### 3944S: INTERNATIONAL ENROLL SPECIAL

Participation in an approved Study Abroad program without direct supervision of the Virginia Tech faculty but with required enrollment in an approved program of study in an international university. Course represents three billable hours and no academic credit. (0C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4004: SEMINAR IN INTERNATIONAL STUDIES

Interdepartmental seminar to synthesize and articulate basic assumptions, theories, and methods of international studies. Senior standing in IS and instructor consent required. (3H,3C)

#### 4014: SEMINAR IN GRASSROOTS DEVELOPMENT

Utilizes development, gender, and social theory to examine the impact of aid programs on communities in the Third World. Analyzes such issues as the impact of development projects in agriculture, natural resources, and employment on the local people, the impact of aid on women; and the policies and administrative structures that direct the world of international development. (3H,3C)

#### 4024 (PSCI 4024): SEMINAR IN DIPLOMACY AND SECURITY

In-depth analysis of selected topics in diplomacy, strategy, and national security including issues pertaining to international conflict and cooperation; dimensions of national power; objectives of national policy and implementation of national strategy; diplomatic negotiations; and conflict resolution. Senior Standing. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 4044 (COMM 4044): INTERNATIONAL COMMUNICATION

Comparative perspectives on global communication systems; problems with the flow of information; roles of international organizations; mass communication and national development; implications for conflict resolution; selected case studies. Senior standing required or instructor consent required. (3H,3C)

#### 4054 (PSCI 4054): SEMINAR IN GLOBAL POLITICAL ECONOMY

Examines theoretical and historical approaches to global political economy and assesses their practical



implications. Focuses on issue areas such as production, trade, money, finance and investment and analyzes their implications for the global economic and political order. Investigates issues pertaining to economies of development and in transition. Senior Standing. Pre: 2064 or PSCI 2064 or GEOG 2064. (3H,3C)

**4064 (PSCI 4064): SEMINAR IN GLOBAL DEVELOPMENT**

Examines how economic and political forces interact in the developing world, discusses the history of these interactions from the pre-colonial period to the present and explores how colonialism shaped the developing world's economic and political trajectories. Utilizes case studies, historical analysis and development economics to better understand the economic and political condition of countries in the developing world. Senior Standing. Pre: 2064 or PSCI 2064 or GEOG 2064. (3H,3C)

**4614 (PSCI 4614): SENIOR SEMINAR IN INTERNATIONAL RELATIONS**

Selected topics in international relations, including objectives of national policy; dimensions and components of national power; comparative diplomacy; international conflict and cooperation; instruments of conflict resolution. Topics vary from semester to semester as announced. Must have senior standing and any two of the prerequisites. Pre: PSCI 3615 or PSCI 3616 or PSCI 3625 or PSCI 3626 or PSCI 3734. (3H,3C)

**4714 (PSCI 4714): SENIOR SEMINAR IN POLICY ANALYSIS**

Theoretical, analytical, and methodological approaches used to assess government activities and public policy. Topics vary from semester to semester as announced. Must have senior standing. Pre: PSCI 3724, PSCI 3734. (3H,3C)

**4734 (PSCI 4734): THEORIES AND PRACTICES OF INTERNATIONAL CONFLICT MANAGEMENT**

Examines alternative perspectives on peace, security, and international intervention and their implications for policy. Focuses on the role of international organizations and other actors in conflict resolution and peace-building and explores issues pertaining to humanitarian intervention, human security, and state-building. Utilizes case studies in peacekeeping and peace building to highlight the link between theory and practice. Pre: PSCI 3616. (3H,3C)

**4735,4736 (PSCI 4735, 4736): MULTILATERAL DIPLOMACY WORKSHOP**

Investigates the purpose, context, and process of multilateral diplomacy and focuses on the strategies and tactics associated with it. Examines format and products of multilateral conferences, decision-making processes, negotiations, mediation, delegation management, and conference management. Utilizes case studies and simulations. 4735: focuses on multilateral diplomacy at the United Nations. 4736: focuses on multilateral diplomacy in the framework of regional international organizations. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

**4744 (PSCI 4744): INTELLIGENCE ANALYSIS WORKSHOP**

Examines the impact of historical experience and bureaucratic structures on intelligence analysis. Discusses the contents of the intelligence agenda and explores issues pertaining to intelligence analysis. Focuses on the intelligence process and offers a target-centric approach to intelligence analysis. Emphasizes and evaluates the use of structured analytic techniques in intelligence analysis. Pre: 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

**4754: INTERNSHIP**

Variable credit course.

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Industrial and Systems Engineering

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### Overview

### Program Educational Objectives and Student Outcomes

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**Head and Professor:** E.M. Van Aken (Interim)

**Interim Associate Department Head and Undergraduate Program Director:** J.P. Shewchuk

**Assistant Head and Graduate Program Director:** M.A. Nussbaum

**Charles O. Gordon Professor:** G. Don Taylor, Jr.

**John Grado Professor:** J.G. Casali

**Hal G. Prillaman Professor:** M.A. Nussbaum

**Paul T. Norton Professor:** S.C. Sarin

**Ralph H. Bogle Professor:** B.M. Kleiner

**John Lawrence Professor:** K.P. Triantis

**Rolls-Royce Commonwealth Professor of Advanced Manufacturing:** J.A. Camelio

**Professors:** J.A. Camelio, J.G. Casali, B.M. Kleiner, M.A. Nussbaum, S.C. Sarin, R.H. Sturges, G. Don Taylor Jr., K.P. Triantis, and E.M. Van Aken

**Associate Professors:** D.R. Bish, E.K. Bish, K.P. Ellis, J.L. Gabbard, L.K. Harmon, Z. Kong, C.P. Koelling, J.A. Nachlas, J.P. Shewchuk, and M.R. Taaffe

**Assistant Professors:** M. Bansal, X. Chen, N. Ghaffarzadegan, N. Hosseinichimeh, R. Jin, B. Johnson, N. Lau, A. Salado, D. Srinivasan, and C. Wernz

**Instructor:** N. Cherbaka

**Faculty Affiliates:** M. Perez and D. Dickerson

**Adjunct Faculty:** R. Edmison, L. Franklin, B. Fraticelli, J. Godfrey, R. Groesbeck, K. Lee, J. Meredith, E. Rashedi, and L. Travis

**Professors Emeritus:** B.S. Blanchard, M.P. Deisenroth, W.J. Fabrycky, P.T. Kemmerling, K.H. E. Kroemer, H.A. Kurstedt, J.A. Nachlas, D. L. Price, J.W. Schmidt Jr., H.D. Sherali, H.L. Snyder, W.G. Sullivan, W.W. Wierwille, and R.C. Williges

**Associate Professors Emeritus:** P. Ghare and R.E. Taylor

**Academic Advisors:** J. Vest and P. Van Curen

Web: [www.ise.vt.edu](http://www.ise.vt.edu)

## Overview

The Grado Department of Industrial and Systems Engineering advances the discipline and imparts knowledge to students, peers and practitioners. In an environment that fosters leadership, achievement, and diversity, we:

- Prepare undergraduate and graduate students for life-long success and leadership in the profession, in industry, and in higher education;
- Conduct and disseminate research that promotes the economic prosperity and well-being of Virginia and the nation; and
- Provide valuable services to industry, society, and the ISE profession.

Industrial and systems engineering is one of the most diverse fields in engineering. ISE is concerned with the design, improvement, and installation of integrated work systems of people, materials, equipment and technology, processes, information, and capital. The industrial engineer is concerned with creating value and improving performance of integrated systems, whether that involves improving quality and productivity, reducing costs and non-value adding activities, improving customer satisfaction, or improving worker safety.

The applications for industrial engineering capabilities include industry, government, and service organizations. Graduates of the ISE program at Virginia Tech work in manufacturing facilities, distribution warehouses, hospitals, airlines, railroads, banks, amusement parks, the military, federal government, and management consulting firms. The boundaries of where IEs make contributions are limitless.

The mission of the ISE Undergraduate Program is to prepare industrial and systems engineering students to create value for organizations, the profession, and society. We achieve this mission by recruiting, retaining, and educating high quality and diverse students and by creating a rigorous and collegial environment enabling students to learn industrial engineering methods and tools, built upon a foundation of mathematical, physical, and engineering sciences, and to apply them in any global organizational setting. Students are able to achieve academic and professional success through opportunities to participate in various educational experiences, to develop capabilities as future leaders, and to embark on a lifelong journey of professional development and learning.

## Program Educational Objectives and Student Outcomes

The ISE faculty, with input from our external Advisory Board, employers, and students, have defined the following Program Educational Objectives (PEOs) and Student Outcomes for our Undergraduate Program. PEOs are statements that describe the expected accomplishments of ISE graduates within 3-5 years after graduation. Student Outcomes are statements that describe what students are expected to know and be able to do at the time of graduation.

**Program Educational Objectives:** Within 3-5 years of graduation, ISE alumni will have:

- Created value by applying the appropriate industrial and systems engineering tools to design/redesign integrated systems/processes, solve problems, implement innovative solutions, and improve organizational outcomes.
- Provided formal and informal project, administrative, or technical leadership.
- Pursued professional development through graduate study, professional certification, or continuing education.

Communicated effectively using written, oral, and visual media adapted to different audiences and stakeholders.

- Worked effectively in cross-functional team environments comprised of members with varying organizational backgrounds, positions, and geographic locations.
- Served the profession, community, and society as exemplified in our motto *Ut Prosim*.

**Student Outcomes:** At the time of graduation, ISE students will have the:

- Ability to apply computational and industrial engineering tools and techniques encompassing manufacturing systems, operations research, human factors and ergonomics, and management systems.
- Ability to apply knowledge of mathematics, statistics, and physical and social sciences to IE problems.
- Ability to identify, formulate, and solve structured and unstructured IE problems.
- Ability to model, analyze, and evaluate work systems and processes, using appropriate experimental design, measurement tools/techniques, and data.
- Ability to generate and evaluate alternatives to design an integrated work system or process through a systems perspective.
- Ability to evaluate the impact of IE solutions in the broader context of the organization and society, with an appreciation of different cultures and perspectives.
- Knowledge of the role of industrial engineers in contemporary issues.
- Ability to communicate effectively to a variety of audiences and using written, oral, and visual media.
- Understanding of professionalism, good citizenship, and ethical behavior.
- Ability to work collaboratively in multi-disciplinary teams.
- Understanding of the need for continued professional development and ability to engage in life-long learning.

The Industrial and Systems Engineering program at Virginia Tech is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

## Curriculum

The ISE curriculum explicitly encompasses coursework useful in addressing not only the technical elements of work systems, but also the organizational, economic, and human elements. Our aim is to provide graduates with the knowledge and capabilities to enable them to successfully pursue careers in industrial engineering or, if qualified, to continue on to graduate study.

ISE emphasizes instruction in fundamental engineering principles based on the physical sciences, engineering sciences, mathematics, and statistics. These principles are applied in practical design experiences throughout the undergraduate curriculum.

Course work in the physical and chemical sciences and mathematics provides a solid background for basic engineering science courses, which in turn support more focused courses in industrial engineering, covering topics in operations research, manufacturing systems engineering, human factors engineering and ergonomics, and management systems engineering. In all these areas, analysis and design activities are supported by modern computing and software tools taught in the curriculum.

Students gain valuable hands-on experience in multiple areas of our curriculum in state-of-the-art laboratory facilities associated with the undergraduate program. These include the ISE Computer Laboratory, which contains computers and printers to support the needs and requirements of ISE students that are not available through access to personal computers or in other laboratories; the Senior Design Center, with computer support and other resource material for student design projects; the Harris Manufacturing Processes Laboratories, which contain robotics and automation equipment, machining equipment, conventional and numerically controlled machine tools, and welding and foundry facilities; the

Human Factors Work Measurement and Methods Engineering Laboratory, which is equipped and used for in-class exercises and experiments in work measurement, motion economy and time study, psychophysics, human audition and vision, and work station design. Students also have the opportunity to work on Undergraduate Research with faculty and graduate students in the many ISE research labs and groups.

The capstone course in the ISE Undergraduate Program is a two-semester class, ISE 4005-6 Project Management & System Design (also referred to as "Senior Design"), where students work in project teams with an external company sponsor to solve a real-world problem. This experience provides ISE students with actual project experience that develops technical and professional skills, such as teamwork, communication, project management, and life-long learning skills, in addition to developing capabilities in applying IE tools and techniques. Student project teams present their project findings at our annual Senior Design Symposium attended by company sponsors and the ISE Advisory Board.

For the 2017 graduation requirements, the course work totals 133 hours. Electives provide students with the opportunity to explore other areas of engineering, as well as cultural, societal and creative experiences, which makes for a well-rounded, diverse, and globally-aware engineer.

The ISE program also provides students with the opportunity to pursue minors, such as a Business Minor, Green Engineering Minor, or Math Minor. More specific information about minors available to ISE students can be found in the ISE Undergraduate Student Handbook, posted on the ISE web site. Students and employers alike are seeing the benefits of these minors for adding value to the ISE major.

Many ISE students seek to participate in Undergraduate Research to satisfy elective requirements in the curriculum. The opportunity to work more closely, in some cases on a one-on-one basis, with our outstanding faculty can provide more in-depth development of ISE capabilities and a more enriching educational experience.

The department participates in the Cooperative Education Program, in which qualified students may alternate semesters of study with semesters of professional co-op employment or internships. Students are encouraged to pursue these experiences before they graduate to make them more competitive in the work force. Students are also encouraged to participate in career fairs and job interviews on and off campus.

The ISE department also provides students with many significant scholarship opportunities at the undergraduate and graduate levels to encourage and acknowledge high academic performance and achievements. The ISE department also maintains bilateral student exchange agreements with international universities, where students can take ISE courses which will transfer back to their BSISE. Students may also select other universities at which to perform a study abroad semester.

Graduate programs leading to the M.S. and Ph.D. are offered (see Graduate Catalog). The graduate programs include concentrations in manufacturing systems engineering, human factors engineering and ergonomics, operations research, management systems engineering, and general IE. The ISE Department also coordinates on- and off-campus master's degree programs in systems engineering (M.S.) and engineering administration (M.E.A.).

## Program Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

Students are strongly encouraged to meet with one of the ISE Academic Advisors to discuss the BSISE curriculum.

## Undergraduate Course Descriptions (ISE)

### 2004: INTRODUCTION TO INDUSTRIAL AND SYSTEMS ENGINEERING

Introduction to the industrial and systems engineering profession through exposure to problems, principles, and practice. Integrated systems approach to problem solving. Foundation of data manipulation and preparation for problem analysis. Development of communication skills, career opportunities, importance of professionalism, ethics, contemporary challenges, lifelong learning, and introduction to the ISE Department. C- or better required in ENGE 1104 or ENGE 1114 or ENGE 1434 or ENGE 1216. Pre: ENGE 1104 or ENGE 1114 or ENGE 1434 or ENGE 1216. (1H,3L,2C)

### 2014: ENGINEERING ECONOMY

Concepts and techniques of analysis for evaluating the value of products/services, projects, and systems in relation to their cost. Economic and cost concepts, calculating economic equivalence, comparison of alternatives, purchase versus lease decisions, financial risk evaluation, cash flow sensitivity analysis, and after-tax analysis. C- or better required in ENGE 1024 or ENGE 1215. Pre: (ENGE 1024 or ENGE 1215) or BC 1224. (2H,2C)

### 2034: DATA MANAGEMENT FOR INDUSTRIAL AND SYSTEMS ENGINEERS

Investigation of data modeling, storage, acquisition, and utilization in industrial and systems engineering via manual and computerized methods. Development of effective spreadsheet applications. Design and implementation of relational databases via entity-relationship modeling, relational schema, and normalization. Web-based database applications. Interface design and the system development life cycle applied to data management applications. All topics covered within the context of typical industrial and systems engineering problems. Pre: CS 1044 or CS 1064. (3H,3C)

### 2204: MANUFACTURING PROCESSES

Survey of manufacturing processes including casting, forming, machining, welding, joining, and non-traditional processes such as laser-beam and electrical-discharge machining. Basic structure of metals, physical, and mechanical properties and their relationship to manufacturing. Process planning and the effect of plans on cost, safety, and the environment. Impact of product design on manufacturability: design for manufacture, assembly, etc. Also include topics in inspection and testing, jigs and fixtures, and numerical control. C- or better required in ENGE 1104 or ENGE 1114 or ENGE 1434 or ENGE 1216. Pre: ENGE 1104 or ENGE 1114 or ENGE 1434 or ENGE 1216. (3H,3C)

### 2214: MANUFACTURING PROCESSES LABORATORY

Laboratory exercises and experimentation in manufacturing processes. Emphasis on using production machines and equipment to make products using multiple manufacturing processes, coupled with inspection per engineering drawings. Processes include assembly, casting, machining, forming, welding, and non-traditional machining, performed manually and/or via computer programming. Also covers basic shop floor operation and documents used for monitoring and controlling part production. C- or better required in ENGE 1104 or ENGE 1114 or ENGE 1434 or ENGE 1216. Pre: ENGE 1104 or ENGE 1114 or ENGE 1434 or ENGE 1216. (3L,1C)

### 2404: DETERMINISTIC OPERATIONS RESEARCH I

Deterministic operations research modeling concepts; linear programming modeling, assumptions, algorithms, modeling languages, and optimization software; duality and sensitivity analysis with economic interpretation; network models (formulations and algorithms), including transportation problems, assignment problems, shortest path problems, maximum flow problems, minimum cost network flow problems, minimal spanning tree problems. A C- or better required in MATH 1114 or MATH 2114. Pre: MATH 1114 or MATH 2114. (3H,3C)

### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3004: INDUSTRIAL COST CONTROL

Fundamentals of general and cost accounting practices applied to manufacturing and service organizations. Cost accounting, standard cost determination, cost and budgetary control systems. C- or better required in ISE 2014. Pre: 2014 or ME 2024. (4H,3C)

#### 3214: FACILITIES PLANNING AND LOGISTICS

Theory, concepts, and methods for designing and analyzing facilities and material flow in manufacturing, storage, and distribution environments. Topic areas include material handling systems, facility layout, facility location, warehousing, distribution, logistics, and transportation. C- or better in ISE 2014, 2404, and 3414. Pre: 2014, 2404, 3414. (3H,3C)

#### 3414: PROBABILISTIC OPERATIONS RESEARCH

This course introduces probability models used to investigate the behavior and performance of manufacturing and service systems under conditions of uncertainty. Major topics include probability, conditioning, elementary counting processes, and Markov chains and Markov processes. Emphasis is on the use of these tools to model queues, inventories, process behavior, and equipment reliability. C- or better required in STAT 4105, MATH 2224 or 2204, MATH 2214 or 2214H, and ISE 2004. Pre: 2004, STAT 4105, (MATH 2224 or MATH 2204), (MATH 2214 or MATH 2214H), (ENGE 2314 or CS 1044 or CS 1064). (3H,3C)

#### 3424: DISCRETE-EVENT COMPUTER SIMULATION

Analysis and design of work systems through static and dynamic simulation. Topics include an introduction to systems analysis and modeling, simulation optimization, model development and testing, and problem analysis through simulation. C- or better required in ISE 3414 and STAT 4105. Pre: 3414, STAT 4105. (2H,3L,3C)

#### 3434: DETERMINISTIC OPERATIONS RESEARCH II

Advanced concepts in deterministic operations research, including theory of complexity, integer programming, advanced linear programming techniques, nonlinear programming, dynamic programming. Covers modeling languages and optimization software for integer programming and nonlinear programming problems. Grade of C- or better required in ISE 2004, 2404 and MATH 2204 or 2224. Pre: 2404, (MATH 2224 or MATH 2204), ISE 2004. (3H,3C)

#### 3614: HUMAN FACTORS ENGINEERING AND ERGONOMICS

Investigation of human factors, ergonomics, and work measurement engineering, with emphasis on a systems approach toward workplace and machine design. Discussion of basic human factors research and design methods, design/evaluation methods for work systems and human machine interactions, human information processing, visual and auditory processes, display and control design, and effects of environmental stressors on humans. C- or better required in ISE 2204 or 2214, STAT 4105, and ISE 2034 and 2004. Pre: (2204 or 2214), STAT 4105, ISE 2034, ISE 2004. (3H,3C)

#### 3624: INDUSTRIAL ERGONOMICS

Introduction to ergonomics and work measurement with an emphasis on people at work. Discussion of methods for work measurement, ergonomic assessment, and evaluation, with major topics including productivity and performance, manual materials handling, work-related musculoskeletal disorders, safety, training and legal issues. C- or better required in ISE 3614. Pre: 3614, ESM 2104. (3H,3C)

#### 4004: THEORY OF ORGANIZATION

A theory of cooperative behavior in formal organizations, including the structure and elements of formal organizations. The executive process and the nature of executive responsibility also are examined. (3H,3C)

#### 4005-4006: PROJECT MANAGEMENT AND SYSTEMS DESIGN

4005: Capstone design experience for ISE majors. Structured systems engineering and project



management methods and tools to plan, manage, and execute technical industrial and systems engineering projects. Students work in teams to apply industrial and systems engineering and project management tools to define and analyze a real-world problem. 4006: Continuation of capstone design experience for ISE majors. Designing, implementing, and evaluating work system solutions. Communication of solutions to various project stakeholders. C- or better in all prerequisites. Pre: 2204, 2214, 3214, 3424, 3624, 2034, 3434, 4404 for 4005; 4005, 4204 for 4006. 4005: (3H,3C) 4006: (2H,2C)

#### 4015,4016: MANAGEMENT SYSTEMS THEORY, APPLICATIONS, AND DESIGN

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. A management process for definition, measurement, evaluation and control, the organization as an information processor, corporate culture, scoping agreements, schemas and management elements, structured design. (3H,3C)

#### 4204: PRODUCTION PLANNING AND INVENTORY CONTROL

Planning and control of operations in both manufacturing and service industries. Effective management and utilization of resources and the production of cost effective products and services. Principles, models, and techniques used for production planning and inventory control. C- or better required in ISE 2404, ISE 3414, and STAT 4706. Pre: 2404, 3414, STAT 4706. (3H,3C)

#### 4214: LEAN MANUFACTURING

Overview of Lean Manufacturing principles, theory, methods, and techniques in modern manufacturing enterprises. Lean philosophy and basic concepts, master production scheduling and production smoothing, assembly line sequencing, setup time reduction, U-shaped line balancing/operation, machine arrangement, kanban, automation, and value stream mapping. Investigation and discussion of lean manufacturing case studies. C- or better required in ISE 4204. Pre: 4204. (3H,3C)

#### 4264: INDUSTRIAL AUTOMATION

A survey of the various technologies employed in industrial automation. This includes an emphasis on industrial applications of robotics, machine vision, and programmable controllers, as well as an investigation into problems in the area of CAD/CAM integration. Examination of the components commonly employed in automation systems, their aggregation and related production process design. Laboratory work is required. C- or better required in ISE 2204 or ISE 2214. Pre: 2204 or 2214. (2H,3L,3C)

#### 4304: GLOBAL ISSUES IN INDUSTRIAL MANAGEMENT

Industrial management topics of current interest explored from a global perspective. Current domestic and international challenges resulting from a global marketplace and the proliferation of information and technology. Industrial management and organizational performance, total quality management, business process re-engineering, leadership, organizational change, role of communication and information, and ethics. Examination and comparison across international boundaries. (3H,3C)

#### 4404: STATISTICAL QUALITY CONTROL

Application of statistical methods and probability models to the monitoring and control of product quality. Techniques for acceptance sampling by variables and attributes are presented. Shewhart control charts for both classes of quality characteristics are examined in depth. The motivation for each method, its theoretical development, and its application are presented. The focus is upon developing an ability to design effective quality control procedures. C- or better required in ISE 3414, STAT 4105, and STAT 4706. Pre: 3414, STAT 4105, STAT 4706. (3H,3C)

#### 4414: INDUSTRIAL QUALITY CONTROL

Implementation of statistical quality control techniques in an industrial setting. Development and analysis of cost models for use in the design of optimal quality control plans. Also included are new techniques, advanced quality control models, and an examination of the role of industrial statistics in the overall product quality assurance function. C- or better required in ISE 4404. Pre: 4404. (3H,3C)

#### 4424: LOGISTICS ENGINEERING

Introduction to the key issues in the integrated support of a product or process. Synthesis of topics from

earlier studies to provide a cohesive approach to their applications. Logistics engineering provides a survey of product support issues and methods of resolving them within the context of the overall production activity. C- or better required in ISE 3414. Pre: 3414. (3H,3C)

#### 4624: WORK PHYSIOLOGY

Anthropometry, skeletal system, biomechanics, sensorimotor control, muscles, respiration, circulation, metabolism, climate. Ergonomic design of task, equipment, and environment. C- or better required in 3624. Pre: 3624. (3H,3C)

#### 4644: OCCUPATIONAL SAFETY AND HAZARD CONTROL

Survey of occupational safety. Topics include: history of occupational safety; hazard sources related to humans, environment, and machines; engineering management of hazards. C- or better required in ISE 3614. Pre: 3614. (3H,3C)

#### 4654: PRINCIPLES OF INDUSTRIAL HYGIENE

Introduction to the foundations of the field of Industrial Hygiene, that discipline devoted to the anticipation, recognition, measurement, evaluation, and control of occupational health hazards. Includes biological (e.g. microbial agents, allergens), chemical (e.g. solvents, carcinogens, dusts), and physical (e.g. radiation, temperature) hazards. Overview of control of health hazards, such as personal protective equipment, administrative controls, and engineering controls. Will involve lecture and participatory "case-study" activities. Will provide ample opportunity for hands-on use of monitoring equipment, protective equipment and controls testing devices. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Interior Design

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**Chair:** L. Tucker

**Associate Professors:** G. Tew, H. Renard, L. Tucker, and B. Whitney

**Assistant Professors:** M. Wagner

**Associate Professor Emeritus:** B. Parsons

Web: [www.archdesign.vt.edu/interior-design/](http://www.archdesign.vt.edu/interior-design/)

## Overview

The interior design program at Virginia Tech is dedicated to improving quality of life through design excellence, professionalism, and public service. With a curriculum that equally respects the importance of creative skill, history, building technology, ethics, innovation, and business practice, our graduates have the ability and confidence needed to immediately contribute to the profession.

Students in the interior program begin their studies in the foundation design laboratory during the first two semesters with architecture, landscape architecture and industrial design students. From the beginning, both an independent and team approach to design solutions is encouraged.

In their professional studies students are challenged to think critically in their design of space and to develop solutions that not only enhance quality of life, but also protect the health, safety, and welfare of users as prescribed in the various codes and regulations that govern the work of interior designers. This philosophy is the core of our program. It establishes a foundation upon which each student graduates with creative ingenuity and professional responsibility.

Our CIDA accredited program prepares future designers for licensure and practice. A degree from a CIDA accredited program is increasingly important as a requirement for professional certification and licensing of Interior Designers in the United States. Graduating from a CIDA accredited program is the first step in a three-part process in achieving certification or licensing as an interior designer in various states. The last two steps are to complete two years of assistantship as an interior designer and then passing the National Council for Interior Design Qualification (NCIDQ) examination. A CIDA accredited degree, work experience and passing the NCIDQ exam satisfy the requirements in Virginia for recognition as a "Certified Interior Designer."

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Urban Affairs and Planning.

Satisfactory progress requirements toward the degree can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (ITDS)

### 1114: DESIGN APPRECIATION

Introduction to fundamental design concepts, design methods and the history of design. Examples drawn from architecture, interior design, industrial design, graphic design as well as vernacular craft and design traditions. Key concepts from art, literature and philosophy are discussed in relation to design theory. (3H,3C)

### 2044: INTERIOR DESIGN I

First in a series of six studios. Foundation level interior design studio. Exploration and development of interior spaces emphasizing spatial volume, human factors, elements and principles of design, and presentation techniques. Pre: ARCH 1016. (1H,12L,6C)

### 2054: INTERIOR DESIGN II

Spatial relationships continue as a priority from ITDS 2044 and become more advanced. Programs of required spaces are introduced in design projects along with issues of human behavior and perception and color. Pre: 2044. (1H,12L,6C)

### 2134: MATERIALS AND METHODS IN INTERIOR DESIGN

Properties and appropriate use of materials in design and construction of building interiors. Floor, wall, and ceiling materials, and materials used in furnishings and equipment are included. Special attention is given to the health effects and environmental impact of material choices in interior design. (3H,3C)

#### 2224: INTERIOR DESIGN GRAPHIC COMMUNICATION

Exploration and development of advanced presentation techniques appropriate for communicating interior design concepts. Special attention is given to utilizing digital media as support for visual and verbal communication. Pre: 2114. Co: 2144. (6L,3C)

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3044: INTERIOR DESIGN III

Exploration and development of interior spaces emphasizing corporate office use, branding of interior environments, and building system integration. Pre: 2054. (1H,12L,6C)

#### 3054: INTERIOR DESIGN IV

Design process, space planning and code compliance with advanced understanding of appropriate concepts for integrating furniture, fixtures, equipment, color, and finish materials in design solutions. Pre: 3044. (1H,12L,6C)

#### 3125,3126: HISTORY IN INTERIOR DESIGN

Surveys of significant developments in the design of interiors and furniture of western civilization. 3125: 3000 BC through the 19th century European. 3126: Colonial America through the 20th century modern design. University Core Area II required. (3H,3C)

#### 3175-3176: BUILDING SYSTEMS FOR INTERIOR DESIGN

Overview of building systems as they relate to the design of building interiors. 3175: overview of building construction including structural systems and materials, code information and thermal concepts related to building systems. 3176: lighting for buildings, sustainable design guidelines, integration of building systems. Pre: 2044 for 3175; 2044, 3175 for 3176. (3H,3C)

#### 3184: CONSTRUCTION DOCUMENTS FOR INTERIOR DESIGN

An overview of construction documents: drawings and specifications. Development of a set of construction documents for a small commercial interior. (3H,3C)

#### 3954: STUDY ABROAD-INTERIOR DESIGN

Variable credit course.

#### 4044: INTERIOR DESIGN V

High-level spatial quality and design solution. Exploration and development of interior spaces for a variety of project types. Focus on collaboration and team work. Pre: 3054. (1H,12L,6C)

#### 4054: INTERIOR DESIGN VI

Senior Thesis studio requiring the integration of research and the design of a self-generated project. Pre: 4044, 4994. (1H,12L,6C)

#### 4114: SUSTAINABLE DESIGN AND LEED

Theoretical approaches to sustainable design as a context for the LEED Green Building Rating Systems. Biophilia, biomimicry, cradle to cradle, and other emerging ways of addressing environmental sustainability are presented. The pre-requisite ITDS 3175 may be waived with instructor's permission. Pre: 3175. (3H,3C)

#### 4554: CONTEMPORARY INTERIOR DESIGN PRACTICE

Study of social, economic, political, and technological issues that influence contemporary interior design practice. Pre: 3126. (3H,3C)

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Landscape Architecture

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**Program Chair:** Brian Katen

**Professors:** P. Miller

**Associate Professors:** D. Bork, T. Clements, W. Jacobson, B. Katen, P. Kelsch, L. McSherry, and M. Kim

**Assistant Professor:** C. L. Bohannon and N. Heavers

**Adjunct Professors:** S. Couchman, M. Ezban, D. Hays, D. Hill, B. Johnson, R. May, and D. McGill

**Professor Emeritus:** B. Johnson

Web: [www.archdesign.vt.edu/landscape-architecture/](http://www.archdesign.vt.edu/landscape-architecture/)

## Overview

Landscape Architecture encompasses the design, analysis, planning, management, and stewardship of sustainable environments. Landscape architects design across a wide spectrum of project scales: garden, community, urban, metropolitan, and regional, as well as at the scale of watersheds and natural systems. The work of the profession is grounded in the natural and social sciences, draws inspiration from nature and the arts, and is implemented through innovative site engineering, construction, land management, and environmental technologies. We believe the work of the profession, at the critical intersection of natural and cultural systems, will be the most consequential of the design arts in the 21st century.

The core of the academic program is a rigorous sequence of design studios that allow students to explore a broad range of landscape architectural issues, contexts, and project types. Studios are accompanied by

discussion, lecture, and laboratory courses that provide systematic and comprehensive coverage of the emerging body of knowledge related to technology, design theory, landscape ecology, and human/environment interaction. Off-campus options include a Europe summer travel studio, study at the Washington Alexandria Architecture Center, Tongji University in Shanghai, or University College, Dublin, Ireland, an independent semester abroad and professional internships.

The Bachelor of Landscape Architecture (B.L.A.) is a five year first-professional degree program fully accredited by the Landscape Architecture Accreditation Board of the American Society of Landscape Architects. Graduates have a wide range of employment and professional opportunities including work in private practice, multidisciplinary firms, public agencies and municipalities, non-government organizations and non-profits.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Urban Affairs and Planning.

Satisfactory progress requirements toward the degree can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (LAR)

### 1144: INTRODUCTION TO LANDSCAPE ARCHITECTURE

Overview of the profession of landscape architecture. Emphasis on the relation of people to the natural and built environment with particular attention to scale, forms, and space. (1H,1C)

### 1254: ENVIRONMENT & NATURAL SYSTEMS

Introduction to the environment and natural systems with emphasis on their relationship to planning and design. Topics include natural elements, structures, patterns, natural systems, ecology, landscape ecology, and sustainability. Application of relevant theories and methods related to the environment and natural systems in planning and design. (3H,3C)

### 1264: SEEING, UNDERSTANDING, REPRESENTING LANDSCAPE

This course explores and compares the potentials and limitations of various approaches to, and techniques for seeing, understanding and representing salient characteristics of landscapes. Directed to landscape architecture majors and interested individuals in related disciplines. (3H,3C)

### 2015-2016: LANDSCAPE ARCHITECTURE DESIGN STUDIO: PLACE AND PROCESS

Basic theory, principles, and methods of landscape design and site planning. 2015: Design theory involving two and three dimensional compositions. Mass/space relationships, principles of spatial design



and techniques used to create landscape space. 2016: Design theory relating to landscape design and site planning. Design of small scale spaces in which the analysis of site, context and the requirements of human use are brought together in a creative synthesis. (1H,11L,6C)

**2164: LANDFORM FUNCTION & AESTHETICS**

Design principles and technology related to the creation of landforms for functional, aesthetic and environmentally sustainable purposes related to landscape design and construction process. Pre-requisite: LAR 1264 or consent of instructor Pre: 1264. (2H,4L,4C)

**2254: SOCIAL AND CULTURAL LANDSCAPES**

Introduction to experiential and cultural content of designed landscapes. Physiological, functional, and psychological factors that affect experience of the landscape. Study of cultural values, attitudes, and philosophies that have shaped historic and contemporary landscapes. (3H,3C)

**2554 (FREC 2554): NATURE AND AMERICAN VALUES**

Introduces students to the evolving relationship between nature and American society; emphasizing the ethics and values which underlie forest, park, and wildlife management. Students are introduced to contemporary land use issues and learn to articulate, defend, and critique the ethical positions surrounding these issues (i.e., wilderness, sustainability, biodiversity, hunting, old growth, suburban sprawl, environmental activism). (3H,3C)

**2984: SPECIAL STUDY**

Variable credit course.

**3015-3016: INTERMEDIATE LANDSCAPE DESIGN AND CONSTRUCTION DOCUMENTS**

Development of intermediate site planning and design knowledge skills. 3015 focuses on site/project scale planning and design with emphasis on greenfield development sites and models of conversation oriented design/development. Pre: 2016 for 3015; 3015 for 3016. (1H,11L,6C)

**3044: 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. Pre: 1004. (2H,2L,3C)

**3154: WATERSHED SENSITIVE SITE DESIGN AND CONSTRUCTION**

Examines soil and water resource issues related to landscape architectural site planning and design. Key topics include watershed sensitive site design, estimation and management of storm water runoff, rainwater conservation, design of open channel conveyances for site planning applications, and erosion and sedimentation control. Pre-requisite: LAR 2164 or consent of instructor Pre: 2164. (2H,4L,4C)

**3164: MATERIALS STRUCTURES DETAILS**

Landscape construction theories and practices involving the selection of materials, design and placement of structures in the landscape and details critical to the creation of space and form. Addresses health, safety and welfare; sustainable materials and construction processes; and environmental performance. Pre-requisite: LAR 3154 or consent of instructor Pre: 3154. (3H,3L,4C)

**3264: PEOPLE, COMMUNITY AND PLACE**

An advanced course focusing on landscape/behavior interactions and implications for the design of outdoor environments. Study of factors that affect social interaction in community and public spaces; perceptions and needs particular to various sub-populations; ecological, social, and cultural approaches to theories of place and place attachment. Pre-requisite: LAR 2254 or instructor's permission Pre: 2254. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course. X-grade allowed.

**3984: SPECIAL STUDY**

Variable credit course.

#### 4004: HISTORY AND THEORY OF LANDSCAPE ARCHITECTURE II

This course studies theoretical and practical developments in landscape architecture and related arts through investigation and analysis of design theory and philosophy, and built form. Pre: 2004 or permission of instructor. Pre: 2004. (3H,3C)

#### 4014: LANDSCAPE PLANNING AND MANAGEMENT

Links landscape architectural design and construction documents through integrating site design from schematic design through design development to construction documentation drawings and technical specifications. Landscape design and technology covered in preceding design and technology courses is combined with construction principles and practices in preparation of site design and set of construction documents. Pre-requisites may be waived with permission of instructor. Pre: 3016, 3164. (1H,11L,6C)

#### 4034: 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 the resulting legislation, technological advancement, and social reform. (3H,3C)

#### 4084: LANDSCAPE DESIGN AND PLANNING STUDIO

This course is an advanced studio that enables students to address landscape architectural design and planning issues in various contexts and at a range of scales. Pre: 3016 or permission of instructor. Landscape Architecture majors must take minimum of 6 credits. May be repeated to a maximum of 12 credit hours. Pre: 3016. (1H,11L,6C)

#### 4094: SENIOR PROJECT

A capstone of a five-year design studio sequence, the senior project is a comprehensive landscape architecture design project selected and completed by the student under the direction of a faculty advisor. Senior projects are reviewed and evaluated by the program faculty. Repeatable with a maximum of 12 credits. Variable credit course. X-grade allowed.

#### 4124 (ARCH 4044): 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. (3H,3C)

#### 4254: LANDSCAPE ARCH THEORIES

Critical examination of theories relevant to landscape architectural design and the inter-relationship between theory and practice. Evolution of theory with respect to built works. Overview of concurrent design theories and philosophies in the related arts. Pre-requisite: Senior standing or instructor's permission. (3H,3C)

#### 4304: TOPICS IN LANDSCAPE ARCHITECTURE

Topics in landscape architecture history, theory and design methods is an advanced course focusing upon 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. Pre: 3015 and 3016 or permission of instructor. May be repeated with different content for a maximum of 12 credits. Pre: (3015, 3016). (3H,3C)

#### 4324: LANDSCAPE ARCHITECTURE TECHNOLOGY III-CONSTRUCTION DOCUMENTS

This course provides the link between landscape architectural design and construction documentation. 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. Pre: 4244. (2H,4L,4C)

#### 4705-4706: LANDSCAPE DESIGN AND PLANNING

Theories, methods, techniques, and tools relating to the planning and design of sites, communities, and regional landscapes. 4705: Emphasis on the development of design ability through the study of: two- and three-dimensional design, principles and elements of spatial composition, and theories and techniques for planning and design of small sites. 4706: Emphasis on the evaluation of land resources and the allocation of land uses within large complex sites and regional landscapes. Theories and techniques of site planning and community design are explored. (1H,8L,5C)

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Life Sciences Undecided

### Overview

**Advisor:** Susan Sumner  
(540) 231-6503, [calsap@vt.edu](mailto:calsap@vt.edu)

Jennifer Carr  
(540) 231-8127, [jjc@vt.edu](mailto:jjc@vt.edu)

### Overview

The College of Agriculture and Life Sciences offers a program for students who are undecided about their major during the first two years at Virginia Tech. This flexibility allows students to explore career opportunities in different fields, to meet faculty in different departments, and to investigate the wide-range of majors and options within the college as well as in the university. Working closely with an advisor in the Office of Academic Programs, students will take foundation courses required of most majors (biological sciences, math, English and chemistry) in the college and be encouraged to take exploratory courses in different departments to sharpen their career focus.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Mathematics

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**Chair:** Peter Haskell

**Associate Chair for Undergraduate Students:** R. C. Rogers

**Director for Undergraduate Programs:** L. Zietsman

**Graduate Director:** S. Sun

**John K. Costain Faculty Chair and Professor:** T. Warburton

**Hatcher Professor of Mathematics:** J. A. Burns

**Virginia Tech Class of 1950 Mathematics Professors:** M. Renardy and Y. Renardy

**Alumni Distinguished Professor:** E. Brown

**Professors:** S. Adjerid, C. A. Beattie, J. Borggaard, E. de Sturler, M. Embree, W. J. Floyd, S. Gugercin, P. E. Haskell, T. L. Herdman, T. Iliescu, J. U. Kim, M. Klaus, W. E. Kohler, T. Lin, P. A. Linnell, C. M. Reidys, R. C. Rogers, J. F. Rossi, M. Shimozone, S. Sun, and J. Turner

**Associate Professors:** S. Ciupe, A. Elgart, N. Loehr, C. Mihalcea, H. Mortveit, A. Norton, P. Wapperom, M. Wawro, P. Yue, and L. Zietsman

**Assistant Professors:** L. Childs, J. Chung, M. Chung, E. Johnson, H. Liu, D. Orr, and E. Palsson

**Patricia Ann Caldwell Post-Doctoral Fellow and Visiting Assistant Professor:** J. Fillman

**Senior Instructors:** D. Agud, S. Anderson, T. A. Bourdon, S. Hagen, and C. Stephens

**Advanced Instructors:** J. Clemons, H. Hart, J. Hurdus, M. P. McQuain, E. Savel'ev, J. Schmale, and J. Wilson

**Instructors:** R. Arnold, T. Asfaw, E. Chang, M. Chung, S. Farmer, W. Galinaitis, N. Gildersleeve, M. Heitzman, E. Jasso Hernandez, S. Mason, T. McIntee, S. McIntyre, E. Rappold, N. Robbins, E. Saenz Maldonado, E. Ufferman, and S. Yasuda

**Lecturers:** E. Adkins and A. Sibol

**Career Advisor:** S. Ciupe  
**Scholarship Chair:** J. Kim

Web: [www.math.vt.edu](http://www.math.vt.edu)

## Overview

Mathematics is essential to a clear and complete understanding of virtually all phenomena. Its precision, depth, and generality support the development of critical thinking and problem-solving skills. The study of mathematics provides the ability to describe applied problems quantitatively and to analyze these problems in a precise and logical manner. This is a principal reason behind the strong demand for mathematicians in government and industry. Essentially all complex problems, whether physical, social, or economic, are solved by designing a mathematical model, analyzing the model, and determining computational algorithms for an efficient and accurate approximation of a solution. Each of these phases is mathematical in nature. For example, if a problem deviates from a standard form, a mathematician should be able to adjust the usual mathematical treatment of the problem to accommodate the deviation. In this case mathematical training provides a practical preparation for a career in today's changing world. Moreover, it is especially valuable because it is an education that equips one to continue to adapt to new situations.

Mathematicians typically are employed as applied mathematicians in their specialty areas. Our recent mathematics graduates have been approximately equally divided among government and industry, graduate school, and teaching. There are four different paths or options that a student may follow towards a B.S. in Mathematics: 1) the Traditional Option; 2) the Applied Computational Mathematics Option (ACM); 3) the Applied Discrete Mathematics Option (ADM); and 4) the Mathematics Education Option (MSTR).

The Traditional Option, as its name implies, yields a broad and flexible background in mathematics. The other three options are more specialized. The ACM option is designed for students primarily interested in computational mathematics and its applications to engineering and the natural and social sciences. The ADM option is designed for students primarily interested in areas of applied mathematics closely associated with computer science. The Mathematics Education Option is designed for students who want to be certified to teach secondary mathematics.

Often students will begin their studies in the Traditional Option and later change to one of the other three options when they become more sure of the path they wish to pursue. One, however, can acquire many aspects of the three specialized options within the Traditional Option, because it also requires some degree of specialization in an applications area and provides career development features. The three specialized options are each less general, but bring particular career paths into sharper focus. Each of the four options provides an excellent foundation for graduate study, either in mathematics or in an applications area. Handbooks for each of the options, as well as mathematics career information, are available upon request.

Approximately \$45,000 in Hatcher, Morris, Layman, Rollins, Steeneck, Caldwell, Wells, Oehring, Eckert, Persinger, Kim, Kimball, and Roselle scholarships is awarded annually to mathematics majors at Virginia Tech: \$5,000 for incoming freshmen and \$40,000 for continuing undergraduates. Information on the scholarships is available from the scholarship chairman in mathematics.

The Cooperative Education Program is also available to qualified candidates, and students wishing to mix practical experience with their formal course studies are encouraged to investigate this option. For more information, contact Career Services at Virginia Tech.

The Mathematics Department firmly believes that mathematics is not only useful and beautiful, but also fun. The department sponsors student chapters of MAA (Mathematical Association of America), SIAM (Society for Industrial and Applied Mathematics), Pi Mu Epsilon (the national mathematics honorary society), and AWM (Association for Women in Mathematics). As well as social activities, these groups sponsor speakers to talk on how mathematics is used in their work. Each fall, Virginia Tech also sponsors the Virginia Tech Regional Mathematics Contest. In addition, students (not all of whom are mathematics majors) annually receive organized preparation and compete in the nationwide William Lowell Putnam Competition and the international Mathematical Contest in Modeling. Individual undergraduate research projects are available to talented students, and a Layman Prize is awarded for the best research project. An overall outstanding senior, as well as an outstanding senior for each option, is recognized each year.

The Honors Program in Mathematics provides outstanding undergraduate majors the opportunity for an enriched academic environment. Through honors courses, an honors project, individual association with the faculty and honors advisors, and other perquisites, the honors student in mathematics enjoys a valuable advantage in the undergraduate experience. Moreover, in coordination with the head of Mathematics and the dean of Science, the honors student may design her/his own individual set of graduation requirements.

In addition to the four undergraduate-degree options, the department also offers the M.S. and Ph.D. Moreover, for qualified students, a combined program is available that leads to both a B.S. and an M.S. in Mathematics. This program saves a year from the usual time required for a B.S. and an M.S. done separately. Students in the Education Option obtain a B.S. in Math and an M.A. in Education by completing four years of undergraduate study and a fifth year in education for a full secondary certification.

The minor is designed to provide recognition for those students who take a program of study in mathematics above the normal requirements of their disciplines.

## Bachelor of Science in Mathematics

### Requirements

Note that the Calculus curriculum is in transition and there are two possible paths through Calculus. We distinguish the two paths as follows: **Path 1** for students who have received credit for MATH 1205 prior to fall 2014 and **Path 2** for students who have not received credit for MATH 1205 prior to fall 2014.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

Those courses listed in the catalog under the subtitles "Basic Sequences for Students in Agriculture, Architecture, Biology, Business, and Liberal Arts and Human Sciences" and "Electives (may not be taken by Mathematics Majors)" may not be used for graduation in mathematics. Special exceptions to this exclusion must have the approval of the head of the department of mathematics.

In order to enroll in 3034, a student must (obtain a C or better in the final attempt of each of 1205, 1206, 1114, and (2224 or 2214)) or (obtain a C or better in the final attempt of each of 1225, 1226, 1114 and

(2204 or 2214)) or (obtain a C or better in the final attempt of MATH 2114). Math students with one C- in the above courses should confer with their advisor.

Each student is required to participate in the department's Outcomes Assessment procedures as determined by each year's Undergraduate Program Committee and approved by the department head.

## Prospective Student Website

A great deal of further information on the Mathematics Program and on mathematical careers can be found on our website at [www.math.vt.edu](http://www.math.vt.edu).

## Minor in Mathematics

### Requirements

A total of 25 semester hours of the following mathematics courses for students who follow Path 1 : Calculus (1205-1206, 1224, 2224); Linear Algebra & ODE's: (1114, 2214); and **9 hours of approved mathematics courses numbered 3000 or higher** or selections from CMDA 3605, 3606, and 4604. Students who follow Path 2, should take a total of 26 semester hours of the following mathematics courses Calculus (1225-1226, 2204) ; Linear Algebra & ODEs (2114, 2214) ; and **9 hours of approved mathematics courses numbered 3000 or higher or selections from CMDA 3605, 3606, and 4604**. Duplications are prohibited. The student must have a 2.00 average in courses used for the minor, none of which may be taken pass/fail.

## Advanced Placement

A student following Path 1 may obtain advanced placement credit for 1205, or 1206, and students following Path 2 may obtain advanced placement credit for 1225 or 1226. The Mathematics Department strongly encourages calculus students to take the C.E.E.B. advanced placement test in calculus.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Mathematics can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (MASC)

The departments of computer science, mathematics, and statistics have joined together to offer the following introductory, interdisciplinary courses in mathematical sciences:

### 1024: MATHEMATICS, A LIBERAL ARTS APPROACH

This is the first course in a sequence that is intended to give those students who will not make extensive use of the Mathematical Sciences in their specialties some insight into Mathematics, Computer Science, and Statistics in an integrated setting. Topics include set theory, number theory, and modular arithmetic. (3H,3C)

### 1044: COMPUTER SCIENCE, A LIBERAL ARTS APPROACH

Intended to provide those students who will not make extensive use of the mathematical sciences in their specialties some insight into the concepts of computer science. Topics include introduction to computer architecture, operating systems, programming languages, and algorithms; history of computing; computer applications in the modern world. Prior credit for any of the following precludes credit for 1044: CS 1104,



1704, or any computer science course at the 2000 level or higher. (3H,3C)

## Undergraduate Course Descriptions (MATH)

### 1014: PRECALCULUS WITH TRANSCENDENTAL FUNCTIONS

Precalculus college algebra, basic functions (algebraic, exponential, logarithmic, and trigonometric), conic sections (parabolas, circles, ellipses, hyperbolas), graphing techniques, basic probability. Use of spreadsheet software. Two units of high school algebra and one of plane geometry are required. Partially duplicates MATH 1015. (3H,3C)

### 1025-1026: ELEMENTARY CALCULUS

1025: Differential calculus, graphing, applications for the life sciences. Use of spreadsheet software. Assumes 2 units of high school algebra, 1 unit of geometry, 1/2 unit of trigonometry, and 1/2 unit of precalculus. 1026: Integral calculus, numerical techniques, elementary differential equations, applications for the life sciences. Use of spreadsheet software. 1025 partially duplicates MATH 1016, 1205, and 1225. 1026 partially duplicates MATH 2015, 1206, and 1226. (3H,3C)

### 1114: ELEMENTARY LINEAR ALGEBRA

Euclidean vectors, complex numbers, and topics in linear algebra including linear systems, matrices, determinants, eigenvalues, and bases in Euclidean space. This course, along with 1205-1206 and 1224, constitutes the freshman science and engineering mathematics courses. 2 units of high school algebra, 1 unit of geometry, 1/2 unit each of trigonometry and pre-calculus required. Partially duplicates MATH 2114. (2H,2C)

### 1205-1206: CALCULUS

Unified calculus course including techniques and applications of differentiation and integration of functions of a single variable. Limits, continuity, differentiation, integration, and transcendental functions. This sequence, together with 1114 and 1224, constitutes the first-year science and engineering mathematics courses. 1205 partially duplicates MATH 1016, 1025, 1225, and 1525. 1206 partially duplicates MATH 1026, 1226, and 2015. Pre 1205: 2 units of high school algebra, 1 unit of geometry, 1/2 unit each of trigonometry and precalculus and placement by Math Dept.; or a grade of B or better in one of 1015, 1016, or 1536; or a passing grade on the Calculus Readiness Exam; Pre: 1205 for 1206. (3H,3C)

### 1224: VECTOR GEOMETRY

Topics in analytic geometry and conic sections, and the calculus of vector-valued functions. This course, along with 1114 and 1205-1206, constitutes the freshman science and engineering mathematics courses. Pre: 1205 or 1225. Co: 1206, 1114. (2H,2C)

### 1225-1226: CALCULUS OF A SINGLE VARIABLE

Unified calculus course covering techniques of differential and integral calculus for functions of one variable. This sequence constitutes the standard first-year mathematics courses for science and engineering. 1225: limits, continuity, differentiation, transcendental functions, applications of differentiation, introduction to integration. Assumes 2 units of high school algebra, 1 unit of geometry, 1/2 unit each of trigonometry and precalculus, and placement by Math Dept. 1226: techniques and applications of integration, trapezoidal and Simpson's rules, improper integrals, sequences and series, power series, parametric curves and polar coordinates, software-based techniques. 1225 partially duplicates 1205, 1016, 1025, and 1525. 1226 partially duplicates 1026, 1206, and 2015. Pre: 1225 (minimum grade of C-) for 1226 (4H,4C)

### 1525-1526: ELEMENTARY CALCULUS WITH MATRICES

1525: Linear, quadratic, exponential and logarithmic functions. Differential calculus with graphical interpretation. Terminology and applications for business, including spreadsheet software. 1526: Integration, substitution and approximation methods. Matrix algebra and solving systems of equations. Partial derivatives and optimization for functions of several variables. Applications for business, including spreadsheet software. 1525 partially duplicates MATH 1016, 1025, 1205, and 1225. 1526 partially duplicates MATH 1114, 2114, 2015, 1026, 1206, and 1226. Assumes 2 unit of high school algebra and 1 unit of plane geometry. (3H,3C)

#### 1535,1536: GEOMETRY AND MATHEMATICS OF DESIGN

1535: Euclidean geometry, isometries, congruencies, similarities. Circles and trigonometry, sequences and the golden ratio. Graph theory, tilings of the plane, polygons and polyhedra. Applications for 2- and 3-dimensional design, including geometric software. 1536: Vectors in the plane and space, lines and planes, and cross product. Descriptive and projective geometry. Differential and integral calculus. Applications for 2- and 3-dimensional design. Assumes 2 units of high school algebra and 1 unit of high school geometry. (3H,3C)

#### 1614: NUMBER AND COMPUTING FOR TEACHERS

A study of the nature and structure of number, number theory, number systems, properties, operations and problem solving which are part of the foundation of the K-8 mathematics curriculum. Computer component includes an emphasis on using spreadsheets to construct mathematical models. (4H,4C)

#### 1624: GEOMETRY AND COMPUTING FOR TEACHERS

A study of key geometry concepts from multiple perspectives including transformational, coordinate, Euclidean and analytical geometry. Geometric and spatial reasoning are part of the foundation of the mathematical curriculum for grades K-8. Computer component integrates the Geometer's Sketchpad, Logo programming language, and other geometry based software. (4H,4C)

#### 2004 (ME 2004): ENGINEERING ANALYSIS USING NUMERICAL METHODS

Numerical methods applied to engineering analysis. Linear systems. Root finding. Numerical integration. Ordinary differential equations. Programming using a software package such as Matlab. Pre: ENGE 1016, (MATH 1206 or MATH 1226), (MATH 1114 or MATH 2114 or MATH 2114H or MATH 2405H). (2H,2C)

#### 2024: INTERMEDIATE CALCULUS

Continuation of Math 1025-1026. Calculus for functions of several variables, differential equations, sequences and series. Applications for the life sciences. Use of spreadsheet software. Partially duplicates MATH 2016, 2224, 2204, and 2214. Pre: 1026 or 2015. (3H,3C)

#### 2114: INTRODUCTION TO LINEAR ALGEBRA

Vector and matrix algebra, systems of linear equations, linear independence, bases, orthonormal bases, rank, linear transformations, diagonalization, implementation with contemporary software. Math 1226 or a grade of at least B in VT MATH 1225. Pre: 1225 or 1226. (3H,3C)

#### 2114H: INTRODUCTION TO LINEAR ALGEBRA

Vector and matrix algebra systems of linear equations, linear independence, bases, orthonormal bases, rank, linear transformations, diagonalization, implementation with contemporary software. Math 1226 or a grade of at least B in VT MATH 1225. Pre: 1225 or 1226. (3H,3C)

#### 2204: INTRODUCTION TO MULTIVARIABLE CALCULUS

Calculus for functions for several variables. Planes and surfaces, continuity, differentiation, chain rule, extreme values, Lagrange multipliers, double and triple integrals and applications, software-based techniques. Partially duplicates MATH 2016, 2024 and 2224. Pre: 1226. (3H,3C)

#### 2204H: INTRODUCTION TO MULTIVARIABLE CALCULUS

Calculus for functions of several variables. Planes and surfaces, continuity, differentiation, chain rule, extreme values, Lagrange multipliers, double and triple integrals and applications, software-based techniques. Partially duplicates 2016, 2024, and 2224. Pre: 1226. (3H,3C)

#### 2214: INTRODUCTION TO DIFFERENTIAL EQUATIONS

Unified course in ordinary differential equations. First-order equations, second- and higher-order linear equations, systems of first-order linear equations, and numerical methods. Partially duplicates 4544. Pre: (1114 or 1114H or 2114 or 2114H), (1206 or 1226). (3H,3C)

#### 2214H: INTRODUCTION TO DIFFERENTIAL EQUATIONS

Unified course in ordinary differential equations. First-order equations, second- and higher-order linear equations, systems of first-order linear equations, and numerical methods. Partially duplicates 4544. Pre: (1114 or 1114H or 2114 or 2114H), (1206 or 1226). (3H,3C)

#### 2224: MULTIVARIABLE CALCULUS

Partial differentiation, multiple integration, and infinite series. Partially duplicates MATH 2204, 2024, and 2016. Pre: (1206 or 1206H or 2015 or 1026), (1224 or 1224H). (3H,3C)

#### 2224H: MULTIVARIABLE CALCULUS

Pre: (1206 or 1206H or 2015 or 1026), (1224 or 1224H). (3H,3C)

#### 2405H-2406H: MATHEMATICS IN A COMPUTATIONAL CONTEXT

Unified course covering topics from linear algebra, differential equations, and calculus for functions of several variables. Comprises the standard second year mathematics courses for science and engineering. 2405H: Vector and matrix algebra, systems of linear equations, linear independence, bases, orthonormal bases, rank, linear transformations and diagonalization. Ordinary linear homogeneous differential equations, implementation with contemporary software. 2406H: Ordinary nonhomogeneous differential equations, calculus for functions of several variables, planes and surfaces, continuity, differentiation, chain rule, extreme values, Lagrange multipliers, double and triple integrals and applications, with software-based techniques. MATH 2405H partially duplicates 2114, 2214. MATH 2406H partially duplicates 2204, 2214. Pre: 1226 for 2405H; 2405H for 2406H. (5H,5C)

#### 2534: INTRODUCTION TO DISCRETE MATHEMATICS

Emphasis on topics relevant to computer science. Topics include logic, propositional calculus, set theory, relations, functions, mathematical induction, elementary number theory and Boolean algebra. Does not carry credit for mathematics majors, but may be used as though it were a 3000-level elective course for the mathematics minor. Partially duplicates 3034. Two units of high school algebra, one unit of geometry, one-half unit each of trigonometry and precalculus mathematics required. Pre: CS 1114 or ECE 1574. (3H,3C)

#### 2644: MATHEMATICS TUTORING

An introduction to mathematics tutoring. Course activities include the development of listening and questioning skills, assessment of a student's mathematical difficulties, and an exploration of teaching and learning processes. In a weekly journal, students will reflect on their tutoring experiences to develop and refine teaching goals and skills. A concurrent mathematics tutoring experience is required. Pre: 1206 or 1226. (1H,1C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2984H: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3034: INTRODUCTION TO PROOFS

Practice in writing mathematical proofs. Exercises from set theory, number theory, and functions. Specific topics include set operations, equivalence relations, mathematical induction, the division algorithm and images and pre-images of sets. Partially duplicates 2534. Pre: Grade of C or better in 2114 or 2114H or 2405H. Pre: 2114 or 2114H or 2405H. (3H,3C)

#### 3054: PROGRAMMING FOR MATHEMATICAL PROBLEM SOLVING

An Introduction to computer programming designed for mathematics majors. Variable types, data

structures, control flow and program structure. Procedural, functional and objective-oriented programming paradigms for solution of a variety of mathematical problems. Co: MATH 2214 or MATH 2214H or MATH 2406H or CMDA 2006. (3H,3C)

#### 3124: MODERN ALGEBRA

Introductory course in groups, rings and fields. Pre: 3034. (3H,3C)

#### 3134: APPLIED COMBINATORICS AND GRAPH THEORY

Emphasis on concepts related to computational theory and formal languages. Includes topics in graph theory such as paths, circuits, and trees. Topics from combinatorics such as permutations, generating functions, and recurrence relations. Pre: (1206 or 1226), (2534 or 3034). (3H,3C)

#### 3144: LINEAR ALGEBRA I

Introductory course in linear algebra. Abstract vector spaces, linear transformations, algorithms for solving systems of linear equations, matrix analysis. This course involves mathematical proofs; it is strongly recommended that students take 3034 first. Pre: 2114 or 2114H or 2405H. (3H,3C)

#### 3214: CALCULUS OF SEVERAL VARIABLES

Fundamental calculus of functions of two or more variables. Implicit function theorem, Taylor expansion, line integrals, Green's theorem, surface integrals. Pre: 2224 or 2224H or 2204 or 2204H or 2406H or CMDA 2005. (3H,3C)

#### 3224: ADVANCED CALCULUS

Theory of limits, continuity, differentiation, integration, series. 3224 duplicates 4525. Pre: (2224 or 2224H or 2204 or 2204H or 2406H or CMDA 2005), MATH 3034. (3H,3C)

#### 3414 (CS 3414): NUMERICAL METHODS

Computational methods for numerical solution of non-linear equations, differential equations, approximations, iterations, methods of least squares, and other topics. Partially duplicates Math 4554 and 4404. A grade of C or better required in CS prerequisite 1044 or 1705. Pre: (CS 1044 or CS 1705 or CS 1114 or CS 1124), MATH 2406H or (CMDA 2005, CMDA 2006) or (MATH 2214 or MATH 2214H), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). (3H,3C)

#### 3574: APPLIED COMPLEX VARIABLES

Arithmetic of complex numbers. Geometry of the complex plane. Geometry of exponentiation and roots. Complex exponential, trigonometric and hyperbolic functions. Continuity and differentiability. Analytic and harmonic functions. Pre: 2204 or 2204H or 2224 or 2224H. (1H,1C)

#### 3624: EARLY TEACHING EXPERIENCE IN MATHEMATICS

An early field experience designed for mathematics students in the mathematics education option. Principles for school mathematics. Secondary school classroom experience and experience-based research. Pre: Junior standing and permission of the instructor. (4H,4C)

#### 4044: HISTORY OF MATHEMATICS

Historical development of mathematics from antiquity to modern times. Senior standing in mathematics required. (3H,3C)

#### 4124: INTRODUCTION TO ABSTRACT ALGEBRA

An introduction to the theory of groups and rings. Topics include normal subgroups, permutation groups, Sylow's Theorem, Abelian groups, Integral Domains, Ideals, and Polynomial Rings. Pre: 3124. (3H,3C)

#### 4134: NUMBER THEORY

Divisibility, congruencies, multiplicative functions, primitive roots, quadratic reciprocity. Pre: 2534 or 3034 or 3134. (3H,3C)

#### 4144: LINEAR ALGEBRA II

Second course in linear algebra. Similarity invariants, Jordan canonical form, inner product spaces, self-adjoint operators, selected applications. Pre: 3144. (3H,3C)

#### 4175-4176: CRYPTOGRAPHY

4175: Elementary concepts in cryptography; classical cryptosystems; modern symmetric cryptography; public key cryptography; digital signatures, authentication schemes; modular arithmetic, primitive roots, primality testing. At least one mathematics course at or above the 3000 level and facility with either a programming language or a computer algebra system is required. 4176: Discrete logs; pseudoprime tests; Pollard rho factoring; groups; quadratic residues; elliptic curve cryptosystems and factoring; coding theory; quantum cryptography. (3H,3C)

#### 4225-4226: ELEMENTARY REAL ANALYSIS

Real number system, point set theory, limits, continuity, differentiation, integration, infinite series, sequences and series of functions. Pre: 3224 for 4225; 4225 for 4226. (3H,3C)

#### 4234: ELEMENTARY COMPLEX ANALYSIS

Analytic functions, complex integration, series representation of analytic functions, residues, conformal mapping, applications Pre: 3224. (3H,3C)

#### 4245-4246: INTERMEDIATE DIFFERENTIAL EQUATIONS

Solution techniques, linear systems, the matrix exponential, existence theorems, stability, non-linear systems, eigenvalue problems. Pre: 3224. (3H,3C)

#### 4254: CHAOS AND DYNAMICAL SYSTEMS

Survey of basic concepts in chaotic dynamical systems. Includes material on bifurcation theory, conjugacy, stability, and symbolic dynamics. Pre: 3224. (3H,3C)

#### 4324: ELEMENTARY TOPOLOGY

Basic concepts of topological spaces, continuous functions, connected spaces, compact spaces, and metric spaces. Pre: 3124, 3224. (3H,3C)

#### 4334: COLLEGE GEOMETRY

Transformational approach to Euclidean geometry including an in-depth study of isometries and their application to symmetry, geometric constructions, congruence, coordinate geometry, and non-Euclidean geometries. Pre: (1114 or 2114 or 2114H or 2405H), (1206 or 1226). (3H,3C)

#### 4404 (AOE 4404): APPLIED NUMERICAL METHODS

Interpolation and approximation, numerical integration, solution of equations, matrices and eigenvalues, systems of equations, approximate solution of ordinary and partial differential equations. Applications to physical problems. Partially duplicates 3414. Mathematics majors or minors cannot take both 4404 and 3414. Pre: 4564, ESM 2074. (3H,3C)

#### 4414 (CS 4414): ISSUES IN SCIENTIFIC COMPUTING

Theory and techniques of modern computational mathematics, computing environments, computational linear algebra, optimization, approximation, parameter identification, finite difference and finite element methods and symbolic computation. Project-oriented course; modeling and analysis of physical systems using state-of-the-art software and packaged subroutines. Pre: (2214 or 2214H or 2406H or CMDA 2006), MATH 3214, (CS 2114 or MATH 3054). (2H,3L,3C)

#### 4425-4426: FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS

Separation of variables for heat, wave, and potential equations. Fourier expressions. Application to boundary value problems. Bessel functions. Integral transforms and problems on unbounded domains. Pre: 2406H or (CMDA 2005, CMDA 2006) or (MATH 2214 or MATH 2214H), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H), MATH 3224 for 4425; 4425 for 4426. (3H,3C)

#### 4445,4446: INTRODUCTION TO NUMERICAL ANALYSIS

4445: Vector spaces and review of linear algebra, direct and iterative solutions of linear systems of equations, numerical solutions to the algebraic eigenvalue problem, solutions of general non-linear equations and systems of equations. 4446: Interpolation and approximation, numerical integration and differentiation, numerical solutions of ordinary differential equations. Computer programming skills required. Pre: 2406H or (CMDA 2005, CMDA 2006) or (MATH 2214 or MATH 2214H), (MATH 2224 or

MATH 2224H) or (MATH 2204 or MATH 2204H) for 4445; 2406H or (CMDA 2005, CMDA 2006) or (MATH 2214 or MATH 2214H), (MATH 2224 or MATH 2224H) for 4446. (3H,3C)

**4454: APPLIED MATHEMATICAL MODELING**

Analysis of classical and modern applications of mathematics in the physical, biological and social sciences. Emphasis on problem formulating, modeling, solving, simulating, and analyzing results. Programming language required. Pre: 3214. (3H,3C)

**4564: OPERATIONAL METHODS FOR ENGINEERS**

Laplace transformations, Fourier series, partial differential equations and separation of variables, boundary value problems, and Sturm-Liouville theory. Pre: (2214 or 2214H) or 2406H or CMDA 2006. (3H,3C)

**4574: VECTOR AND COMPLEX ANALYSIS FOR ENGINEERS**

Vector Analysis: Green's theorem, potential theory, divergence, and Stokes' theorem. Complex Analysis: Analyticity, complex integration, Taylor series, residues, conformal mapping, applications. Pre: 2224 or 2204 or 2204H. (3H,3C)

**4625,4626: MATHEMATICS FOR SECONDARY TEACHERS**

Course activities will emphasize the curricular themes of problem solving, reasoning and proof, communication, connections, and representation. 4625: Topics in discrete mathematics and algebra from a secondary teaching perspective. 4626: Topics in trigonometry, geometry, measurement, statistics, and probability from a secondary teaching perspective. Pre: 3034. (3H,3C)

**4644: SECONDARY SCHOOL MATHEMATICS WITH TECHNOLOGY**

Use and impact of technology in secondary mathematics curriculum. Various technologies including graphing calculators, calculator based laboratory and probes (CBLs), computer algebra systems, spreadsheets, dynamic geometry software and the Internet will be used to explore secondary mathematical concepts from an advanced viewpoint. Pre: 3034. (3H,3C)

**4664: SENIOR MATH EDUCATION SEMINAR**

A review of basic principles and problem-solving techniques in the eleven topics covered by the Praxis II (Mathematics Content Knowledge) examination. Passing the Praxis II examination prior to student teaching is a state requirement for all students seeking secondary licensure. Passing Praxis I required. Pre: 3124. (2H,2C)

**4754: INTERNSHIP**

May be repeated for a maximum of 12 credits. Pass/Fail only. Variable credit course.

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Honors section. Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Honors section. Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Mechanical Engineering

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**Head:** Azim Eskandarian

**William S. Cross Professor:** D. K. Tafti

**George R. Goodwin Professor:** R. Pitchumani

**Robert E. Hord, Jr. Professor:** S. Priya

**Samuel P. Langley Professor:** C.R. Fuller

**W. Martin Johnson Professor:** A.J. Kurdila

**Chris C. Kraft Professor of Engineering:** W. F. Ng

**J. Bernard Jones Professor:** W.F. O'Brien

**Rolls Royce Professor:** S. Ekkad

**L. S. Randolph Professor:** R. G. Parker

**Dan Pletta Professor:** M. Ahmadian

**Professors:** M. Ahmadian, F. Battaglia, R.A. Burdisso, H. Chelliah, T.E. Diller, S. Ekkad, A. Eskandarian, C.R. Fuller, T. Furukawa, A. Haghighat, W. Hardy, J.M. Kennedy, A.J. Kurdila, R.L. Mahajan, D.J. Nelson, W.F. Ng, W.F. O'Brien, R. Parker, M.R. Paul, R. Pitchumani, S. Priya, C. Sandu, D.K. Tafti, S. Taheri, and M.R. von Spakovsky

**Associate Professors:** J. Bayandor, B. Behkam, P. Ben-Tzvi, J.H. BÃ¶hn, J. Cheng, C.L. Dancy, W. Deng, M.W. Ellis, J.B. Ferris, S. Huxtable, M.E.F. Kasarda, K.B. Kochersberger, A.A. Kornhauser, A. Leonessa, R. MÃ¶ller, A.S. Nain, R. Qiao, M.J. Roan, S.C. Southward, B. Vick, R.L. West, A.L. Wicks, C.B. Williams, and L. Zuo

**Assistant Professors:** A. Asbeck, C. Hin, L. Li, Z. Li, Y. Liu, R. Mirzaeifar, P. Tarazaga, Z. Tian, and X. Zheng.

**Associate Professor of Practice:** R. Ott, M.A. Pierson, and L. Vick

**Professors Emeritus:** L.J. Arp, R.A. Comparin, N.S. Eiss, R.E. Hedgepeth, C.J. Hurst,

J.B. Jones, R.G. Kirk, R.G. Leonard, J. R. Mahan, L.D. Mitchell, R. Mitchiner, J. Moore, A. Myklebust, T.F. Parkinson, F.J. Pierce, J.R. Thomas, W.C. Thomas, and R.J. Whitelaw  
**Adjunct Professors:** R. Anderl (TU Darmstadt), P.G. Brolinson (Edward Via College of Osteopathic Medicine), D. Carlson (Lord Corp.), J. Funk (Biodynamic Research Corp.), M.J. Hampe (TU Darmstadt), T. Kress (BEST Engineering), D. Rabe (Air Force Research Lab), and B. Sanders (Air Force Research Lab)

Web: [www.me.vt.edu](http://www.me.vt.edu)

## Nature of the Profession

Mechanical engineering is the broadest of the engineering professions. Because of the breadth of the ME discipline, mechanical engineers work in a wide variety of technical areas and are employed in a range of job functions. Specialty areas within the mechanical engineering discipline include, among many others, acoustics, biomechanics, CAD, controls, energy conversion and energy management, HVAC, materials, mechanical design, mechatronics, nuclear engineering, robotics and automation, and turbomachinery. The actual job functions which mechanical engineers perform vary widely as well. ME's work in design, research and development, manufacturing, service and maintenance, as well as technical sales, in almost every industry. Many are in management and administration. Many mechanical engineering graduates go on to more advanced degrees, or continue their education in other fields, such as law or business.

## Employment Opportunities

Because of the diversity and breadth of the mechanical engineering profession, ME graduates find employment in a wide variety of industries, laboratories, and consulting firms. This results in a relatively stable job market that is not dependent upon a single particular industry. The textile, petroleum, chemical, electronic, automotive, aerospace, power generation, HVAC, and manufacturing industries hire large numbers of mechanical engineering graduates and the starting salaries for ME's are very competitive with the other engineering disciplines.

Because of the wide diversity of specialties and job functions any two mechanical engineers might have significantly different day-to-day activities and responsibilities. Some may be concerned with very large engineering systems while others are working with small and even microscale devices and components; some work might call for highly analytical or mathematical approaches while other work might be more amenable to experimental or empirical approaches. Mechanical engineers may be involved in the operation of processing plants, or the design of engines, prosthetic devices, steam and gas turbines or compressors and pumps, alternative fuel devices, and many other devices and systems. At Virginia Tech there is a close association between the ME departments research and design project activities with industry. This enhances the opportunities for student interaction with industry representatives.

## Mechanical Engineering Program Educational Objectives

Within a few years after graduating from the Mechanical Engineering Department at Virginia Tech, the graduates will attain:

- Positions where they utilize fundamental technical knowledge and skills in mathematics, science, and engineering to analyze and solve problems, and apply these abilities to generate new knowledge, ideas or products in academia, industry or government.
- Practical experience and organizational skills, enabling them to interact and communicate effectively (written and/or oral) with others (e.g., supervisor, client and/or team) with regard to the diversity of



the stakeholders involved in their work.

- Roles of increasing responsibility leading to leadership positions that benefit themselves, their employers and society.
- Skills in life-long learning through: (a) self-study, (b) continuing education/short courses or workshops, and/or (c) formal graduate level education, and encourages co-workers to have this same motivation.
- Roles in professional and personal life where they demonstrate professional and ethical responsibilities toward peers, employers, and society and follow these precepts in their daily lives.

## Program Outcomes

We expect our students to have the following skills, knowledge, and behaviors by the time of their graduation. We want our students to attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The Bachelor of Science in Mechanical Engineering (BSME) degree program at Virginia Tech is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

One important objective of the Department of Mechanical Engineering is to ensure that every mechanical engineering graduate has the knowledge, ability, and understanding required to meet the basic ABET guidelines. The structure and sequence of courses is designed to provide these requirements for every graduate. The department is committed to providing students with an exceptional experience in both the theory and practice of mechanical engineering. In the senior capstone sequence, students are required to apply classroom knowledge to complex engineering problems requiring teamwork, problem formulation, economic analysis, effective communication, and product realization. These projects are carefully selected and updated to ensure relevancy to contemporary technical issues and needs. The department encourages the involvement of underclass students and students outside the department and college in these projects. The department also encourages hands-on student involvement by providing dedicated machine and welding shops that exclusively serve the undergraduate program. The required sophomore-level Manufacturing Processes Laboratory course and certification by a professional machinist are required prior to use of either of these shops. Opportunity for professional development is provided by participation in student professional organizations, such as the American Society of Mechanical Engineers, ASME, and the American Nuclear Society, ANS.

## The Curriculum

A total of 131 semester credits are required for graduation. Please refer to the [Registrar's website](#) for official program checksheets showing the graduation requirements and recommended course plans. Unofficial documents are available on the ME website showing prerequisite relationships to courses and

alternative course plans (e.g. for co-op students and military 4.5 and 5-year plans).

[www.me.vt.edu/academic-programs/undergraduate-program/current-students/course-selection/#requiredcourses](http://www.me.vt.edu/academic-programs/undergraduate-program/current-students/course-selection/#requiredcourses)

The ME curriculum provides a strong foundation in the basic physical and chemical sciences and in mathematics. These are followed by a sequence of courses that provide a broad background in design methodology, computer programming, electronics, solid and fluid mechanics, manufacturing processes, system modeling, machine design, thermodynamics, heat and mass transfer, statistics and materials. Courses in English and in the humanities and social sciences are included to broaden the individual. This background is strengthened and unified through a sequence of engineering design and laboratory courses. Instructional laboratories in the junior and senior years provide opportunities for students to learn measurement and instrumentation techniques. Students apply these skills to the acquisition and analysis of data from various engineering systems.

In all professional endeavors the mechanical engineer must consider ecological effects as well as the economic and social needs of people. The mechanical engineer must consider the conservation of natural resources and the environmental impact in the design of systems. These considerations are included in a number of ME courses and technical elective classes. Students wishing to further strengthen this area may wish to consider the Green Engineering Option at [www.eng.vt.edu/green/index.php](http://www.eng.vt.edu/green/index.php).

The unifying activity in all aspects of mechanical engineering is the design function. A special emphasis has been placed on the use of computer-aided design methods and applied design project experience as a required part of the curriculum. Elective courses in the junior and senior years provide students with the opportunity to pursue specialized interests related to career plans or preparation for graduate study.

The department participates in the Cooperative Education Program in which qualified students may alternate semesters of study with semesters of professional employment. Approximately twenty percent of all mechanical engineering students participate in this program.

## Education Abroad Programs

The Department of Mechanical Engineering is a world leader in providing high-quality education abroad opportunities to its students and preparing them to function effectively as true global engineers. The cornerstone of this strategy is the Ultimate Global Engineer Program, which identifies three major windows of opportunity for students to attend topflight mechanical engineering programs abroad and graduate on time. Students can select to participate in any combination of one, two, or even all three of these windows of opportunity:

**Windows #1:** Fall semester sophomore year in a country where the language of instruction is English. Currently students can attend the University of Melbourne, the top-ranked mechanical engineering program in Australia.

**Windows #2:** Rising junior summer in a country with a non-English language but where the language of instruction is English. Currently students can attend Shanghai Jiao Tong University, the top-ranked mechanical engineering program in China. This program is particularly well suited for students that need to catch up on their course work, reduce their junior-year course load, or get ahead on their course work.

**Windows #3:** Senior year abroad in a country with a non-English language but where the language of instruction is non-English. Currently students can attend the Technische Universität Darmstadt (TUD), the top-ranked mechanical engineering program in Germany. Language training is integrated into the curriculum, starting as late as spring semester junior year. Students have the opportunity to simultaneously earn both a VT BSME degree and a TUD BSME degree.

For more information about these and other exiting education abroad programs offered by the Department of Mechanical Engineering, please visit:

<http://www.me.vt.edu/international>

<http://www.tud.vt.edu/BS>

## Entrance Requirement

The College of Engineering at Virginia Tech limits the number of students who may transfer into any particular department, with that number based upon the number of faculty in each separate department. Refer to the Engineering Education website at [www.enge.vt.edu](http://www.enge.vt.edu) for the latest information on transferring into the ME department. The ME academic advisor may also be consulted for information on anticipated entrance requirement changes.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the Curriculum for Liberal Education (see Academics chapter in this catalog), and toward the degree in mechanical engineering.

Satisfactory progress toward a B.S. in Mechanical Engineering includes the following minimum criteria:

- Complete a minimum of 12 credits that apply toward the BSME each year
- maintain an in-major GPA (all ME and NSEG courses) of at least a 2.0
- maintain an extended in-major GPA of at least 2.0 (in all ME, NSEG courses plus ESM 2104, 2204, and 2304).
- complete ESM 2104, Math 2114 and Math 2204 within 45 attempted required course credits (not to include CLE courses, technical electives or free electives)
- complete ESM 2304, ME 2124, and Math 2214 within 60 attempted required course credits (not to include CLE courses, technical electives, or free electives)
- complete ME 3124, ME 3514 and ME 3614 within 72 attempted required course credits (not to include CLE courses, technical electives, or free electives)
- complete ME 4006, ME 4015 and ME 4124 within 90 attempted required course credits (not to include CLE courses, technical electives, or free electives)

The department offers graduate programs leading to the M.S., M.Eng., and Ph.D. in mechanical engineering (see the [Graduate Catalog](#)).

The Department of Mechanical Engineering actively seeks input on the nature and quality of our program from all interested individuals and organizations, including students, employers and supporting agencies. Our goal is to provide the best possible service to the students who entrust their education to us. Through our continuous improvement efforts, we pledge to continually improve the content of our curriculum, our educational methods and our facilities. Comments to the department head or any member of the faculty are welcomed. Note that because of this continuous improvement process entrance and degree requirements and course content are subject to change. Please consult the department academic advisor for current information.

## Undergraduate Course Descriptions (ME)

### 2004 (MATH 2004): ENGINEERING ANALYSIS USING NUMERICAL METHODS

Numerical methods applied to engineering analysis. Linear systems. Root finding. Numerical integration. Ordinary differential equations. Programming using a software package such as Matlab. Co: (MATH 1226 or MATH 1206), (MATH 2114 or MATH 1114) Pre: (ENGE 1114 or ENGE 1434 or ENGE 1216). (2H,2C)

### 2024: INTRODUCTION TO ENGINEERING DESIGN AND ECONOMICS

Design process, mini-design projects, collaborative design, product dissection, economics of decision making, reverse engineering, intellectual property, oral, written, and graphic communications, engineering ethics. Pre: (ENGE 1216 or ENGE 1114 or ENGE 1434). Co: ESM 2104, PHYS 2306. (3H,3C)

### 2124: INTRODUCTION TO THERMAL AND FLUID ENGINEERING

Basics of thermodynamics, fluid mechanics, and heat transfer. Fluid and thermal properties of materials.

Ideal gas equation of state. First law of thermodynamics in closed systems. Transient heat transfer. First law of thermodynamics in open systems. Fluid mechanics balances, open systems. Emphasis on applications in all topic areas. Pre: ESM 2104, (MATH 2114 or MATH 2114H). Co: MATH 2214. (2H,2C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 2994H: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3124: THERMODYNAMICS

Classical thermodynamics and its applications. Thermodynamic properties of pure substances: property tables, property software, equations of state. First law of thermodynamics. Second law of thermodynamics. Gas mixtures. Combustion: atom and energy balances. Power and refrigeration cycles. Pre: (2124, MATH 2214, MATH 2204) or (ME 2124, MATH 2214, MATH 2204H) or (ME 2124, MATH 2214, MATH 2224) or (ME 2124, MATH 2214, MATH 2224H) or (ME 2124, MATH 2214H, MATH 2204) or (ME 2124, MATH 2214H, MATH 2204H) or (ME 2124, MATH 2214H, MATH 2224) or (ME 2124, MATH 2214H, MATH 2224H) or (ME 2124, MATH 2405H, MATH 2406H). (3H,3C) I,II.

#### 3134: FUNDAMENTALS OF THERMODYNAMICS

Fundamental concepts, first and second laws, gas and vapor processes with emphasis on chemical reactions, statistical interpretation of entropy, limited use of thermodynamic property tables. This course is for non-ME students. Pre: MATH 2214 or MATH 2214H. (3H,3C)

#### 3304: HEAT AND MASS TRANSFER

Comprehensive basic course in heat and mass transfer for mechanical engineering students. Principles of conduction, convection, and radiation with applications to heat exchangers and other engineering systems. Pre: (2124, MATH 2214, MATH 2204) or (ME 2124, MATH 2214, MATH 2204H) or (ME 2124, MATH 2214, MATH 2224) or (ME 2124, MATH 2214, MATH 2224H) or (ME 2124, MATH 2214H, MATH 2204) or (ME 2124, MATH 2214H, MATH 2204H) or (ME 2124, MATH 2214H, MATH 2224) or (ME 2124, MATH 2214H, MATH 2224H) or (ME 2124, MATH 2405H, MATH 2406H). (3H,3C)

#### 3404: FLUID MECHANICS

Comprehensive first course in basic and applied fluid mechanics. Fluid properties, statics, kinematics, and dynamics. Euler's and Bernoulli's equations. Hydrodynamics. Dimensional analysis and similitude. Real fluids, laminar and turbulent flows. Boundary layer model and approximate analysis. Compressible flow and propulsion devices. Flow measurement. Introduction to turbomachinery with applications. Pre: (2124, MATH 2214, MATH 2204) or (ME 2124, MATH 2214, MATH 2204H) or (ME 2124, MATH 2214, MATH 2224) or (ME 2124, MATH 2214, MATH 2224H) or (ME 2124, MATH 2214H, MATH 2204) or (ME 2124, MATH 2214H, MATH 2204H) or (ME 2124, MATH 2214H, MATH 2224) or (ME 2124, MATH 2214H, MATH 2224H) or (ME 2124, MATH 2405H, MATH 2406H). (3H,3C)

#### 3504: DYNAMIC SYSTEMS - VIBRATIONS

Principles of dynamic system modeling with emphasis on second order mechanical systems. Harmonic and nonharmonic vibrations of single and multi-degree of freedom systems. Applications of computer simulation and analysis techniques in vibrations. Pre: (3514, MATH 2214) or (ME 3514, MATH 2214H) or (ME 3514, MATH 2405H, MATH 2406H). (3H,3C)

#### 3514: SYSTEM DYNAMICS

Mathematical descriptions of physical systems' behavior including mechanical, electrical, thermal,

and fluid systems and their combinations; system descriptions using state variable and transfer functions; analysis of system responses: convolution integral, frequency response, numerical simulations, and Laplace transform methods; systems concepts: input-output, causality, and analogies; general process descriptions including first-order, second-order, and time delayed. Pre: (ESM 2104, ESM 2304, MATH 2214, MATH 2204, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214, MATH 2204, MATH 2114H) or (ESM 2104, ESM 2304, MATH 2214, MATH 2204, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2214, MATH 2204H, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214, MATH 2204H, MATH 2114H) or (ESM 2104, ESM 2304, MATH 2214, MATH 2204H, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2214, MATH 2224, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214, MATH 2224, MATH 2114H) or (ESM 2104, ESM 2304, MATH 2214, MATH 2224, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2214, MATH 2224H, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214, MATH 2224H, MATH 2114H) or (ESM 2104, ESM 2304, MATH 2214, MATH 2224H, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2204, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2204, MATH 2114H) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2204, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2204H, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2204H, MATH 2114H) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2204H, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2224, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2224, MATH 2114H) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2224, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2224H, MATH 2114) or (ESM 2104, ESM 2304, MATH 2214H, MATH 2224H, MATH 2405H) or (ESM 2104, ESM 2304, MATH 2405H, MATH 2406H). (3H,3C)

#### 3604: KINEMATICS AND DYNAMICS OF MACHINERY

Kinematic analysis and design of cams, gears, and linkages, velocity, acceleration and force analysis, kinematic synthesis, balancing, kinematic and force analysis by complex numbers, computer-aided analysis, and synthesis of linkages. Pre: ESM 2304. (3H,3C)

#### 3614: MECHANICAL DESIGN I

Design of mechanical components subject to static and fatigue loads. Design using screws, fasteners, springs and bearings. Computer-aided design using transfer matrix and finite element methods. Pre: (ESM 2104, ESM 2204, MATH 2214, MATH 2204) or (ESM 2104, ESM 2204, MATH 2214, MATH 2224) or (ESM 2104, ESM 2204, MATH 2214H, MATH 2204) or (ESM 2104, ESM 2204, MATH 2214, MATH 2204H) or (ESM 2104, ESM 2204, MATH 2214H, MATH 2204H) or (ESM 2104, ESM 2204, MATH 2405H, MATH 2406H). (3H,3C)

#### 4005-4006: MECHANICAL ENGINEERING LAB

Principles of measurement, measurement standards and accuracy, detectors and transducers, digital data acquisition principles, signal conditioning systems and readout devices statistical concepts in measurement, experimental investigation of engineering systems, technical report writing. Pre: 3514, (ECE 2054 or ECE 3054) or (ECE 2004, ECE 2074), (STAT 3704 or STAT 4604 or STAT 4705 or STAT 4714) for 4005; 4005, ECE 3254 for 4006. Co: ECE 3254 for 4005. (2H,3L,3C)

#### 4015-4016: ENGINEERING DESIGN AND PROJECT

Team oriented, open-ended, multi-disciplinary design projects focused on industrially relevant problems. A specific, complex engineering design problem is normally taken from problem definition to product realization and testing. Emphasis is placed on documenting and reporting technical work, idea generation and selection, application of design and analysis tools developed in previous courses, project management, selling technical ideas and working in teams. Pre: (4005, 2024, ECE 3254, ME 3614, ME 3304), (ME 3504 or ME 4504) for 4015; 4015 for 4016. (2H,1L,3C)

#### 4034: BIO-INSPIRED TECHNOLOGY

Introduction to engineering solutions inspired by biological systems. Overview over the approach of bio-inspired technology and the state of the art. Exploration of the relationship between engineered and natural biological systems. Explanation of concepts of biological systems, such as evolutionary optimization, sensing, actuation, control, system integration, assembly and materials in engineering terms. Practice of interdisciplinary analysis skills in technical report writing projects where man-made and biological systems are evaluated for parallels to engineering and their technological potential. Pre: (PHYS 2205, PHYS 2206) or (PHYS 2305, PHYS 2306). (3H,3C)

#### 4124: COMPUTER AIDED DESIGN OF FLUID-THERMAL SYSTEMS

Review of physical laws and engineering concepts introduced in thermodynamics, fluid mechanics, and heat transfer with applications. Emphasis on analysis, modeling, and design of engineering systems, components, and physical phenomena with state-of-the-art computer software such as Ansys CFX, Star CCM, Aspen Plus, and ProSimPlus. Pre: 3124, 3304, 3404. (2H,2L,3C)

#### 4154: INDUSTRIAL ENERGY SYSTEMS

Survey of energy-intensive technologies used in typical industrial plants, with emphasis on cost-effective energy conservation. Burners, boilers, pumps, air compressors, electric motors, lights, refrigeration plants, HVAC systems, cogeneration systems, waste heat recovery equipment. Energy-efficient design and operation. Determination of energy efficiency based on field measurements. Economic analysis of energy conservation measures. Mitigation of environmental impacts. Pre: 3114 or 3124 or 3134 or CHE 2164 or BSE 3154. (3H,3C)

#### 4164: ENERGY SYSTEMS FOR BUILDINGS

Application of the fundamental principles of thermodynamics, heat transfer, and fluid flow to analyze energy use for building environmental control. Exploration of approaches for configuring basic thermal-fluid engineering components (e.g. pumps, piping, fans, heat exchangers, refrigeration cycles, etc.) to yield systems that provide heating, cooling, and ventilation. Introduction to techniques and software tools for estimating energy use by these systems and the associated economic and environment impact. Examination of alternate technologies for meeting building energy needs including small scale combined heat and power systems and renewable energy systems. Pre: 2124, 3124. (3H,3C)

#### 4174 (AOE 4174): SPACECRAFT PROPULSION

Spacecraft propulsion systems and their applications in orbital, interplanetary, and interstellar flight. Rocket propulsion fundamentals; advanced mission analysis; physics and engineering of chemical rockets, electrical thrusters, and propellantless systems (tethers and sails); spacecraft integration issues. Pre: 4234 or AOE 4234. (3H,3C)

#### 4194 (ESM 4194): SUSTAINABLE ENERGY SOLUTIONS FOR A GLOBAL SOCIETY

Addresses energy metrics, global and US energy supply and demand, transitional energy sources (natural gas, petroleum, coal, nuclear), sustainable/renewable source (solar, geothermal, hydro, tidal, wind, biofuels), and methods for increasing efficiencies (energy storage, batteries, green building, conservation). Options for transportation, electricity, lighting and heating needs of industry, agriculture, community, and citizens. Production, transmission, storage, and disposal issues considered in the context of global political, economic, and environmental impacts. Senior Standing in major may be substituted for pre-requisite ENGL 3764. Pre: (CHEM 1035 or CHEM 1055), PHYS 2306, ENGL 3764. (3H,3C)

#### 4204: INTERNAL COMBUSTION ENGINES

Analysis and design of gasoline and diesel engines. Fundamental processes and their application in current technology. Thermodynamics: air standard and air-fuel cycles. Combustion: stoichiometry, fuels, chemical equilibrium, chemical kinetics, flame propagation, knock, pollutant formation and control. Flow processes: volumetric efficiency, intake and exhaust tuning, two-stroke scavenging, carburetion, fuel injection, super- and turbo-charging. Pre: 3124, 3404. (3H,3C)

#### 4224: AIRCRAFT ENGINES AND GAS TURBINES

Performance and characteristics of aircraft engines and industrial gas turbines, as determined by thermodynamic, fluid mechanic, heat transfer, and solid mechanic behavior of components. Operational limitations and component matching. Stress and associated temperature limits and influence of blade cooling techniques on turbines. Pre: 4234 or 4124. (3H,3C)

#### 4234 (AOE 4234): AEROSPACE PROPULSION SYSTEMS

Design principles and performance analysis of atmospheric and space propulsion engines and systems. Application of thermodynamics, compressible fluid flow and combustion fundamentals to the design of gas turbine and rocket engines and components, including inlets, turbomachines, combustors, and nozzles. Matching of propulsion system to vehicle requirements. Must have a C- or better in pre-requisites ME 3404 and ME 3124 or AOE 3114 and AOE 3134. Pre: (3404, 3124) or (AOE 3114, ME 3134). (3H,3C)

#### 4244 (AOE 4244): MARINE ENGINEERING

Analysis of major ship propulsion devices (propellers, water jets). Integration with propulsion plant and machinery. Characteristics of marine steam turbines, nuclear power plants, marine diesels, and marine gas turbines. Shafting system, bearings, and vibration problems. Must have a C- or better in pre-requisites AOE 3204 and ME 3124 or ME 3134. Pre: AOE 3204, (ME 3134 or ME 3124). (3H,3C)

#### 4324: ENERGY SYSTEMS: THEORY AND APPLICATIONS

Theory and applications of thermodynamic and fluid mechanics principles as applied to energy systems. Fundamental concepts on exergy, mixtures, psychrometry and thermochemistry. Analyses and applications include vapor and gas power systems, refrigeration, air conditioning, combustion processes and one-dimensional compressible flow. Pre: 3124, 3404. (3H,3C)

#### 4344 (CHE 4304): BIOLOGICAL TRANSPORT PHENOMENA

Engineering analysis and predictive modeling of heat and mass transport in biological systems (e.g., tissues, organs, organisms, and biomedical devices). Examination of processes that involve conduction, convection, diffusion, generation/consumption. Application of analytical and computational methods to solve differential equations that describe unsteady and/or multi-dimensional transport. Topics include oxygen transport, pharmacokinetic analysis, kidney function, blood perfusion, burns, and cryopreservation. Pre: (CHE 3114, CHE 3044, CHE 3144) or (ME 3304, ME 3404) or (CHE 3114, CHE 3044, CHE 3144) or (ME 3304, ME 3404). (3H,3C)

#### 4454 (EDCI 4454): ENGINEERING LEADERSHIP IN PRACTICE: MANAGING THE TECHNICAL DESIGN PROCESS

Introduction to management and mentoring skills associated with the application of the engineering design process. Course covers skills necessary for leading diverse teams of people through a technical design project. Managing teams of local high school students through an authentic technical design experience associated with design competitions. Course addresses the practical applications of science, math and engineering, while building and managing teams of people to meet technical project goals. Pre-requisite: ME 4015 or similar team-based design experience, or by permission of instructor. Pre: 4015. (2H,3L,3C)

#### 4504: DYNAMIC SYSTEMS - CONTROLS ENGINEERING I

Fundamentals of feedback control theory, classical analysis and design techniques for automatic controls, introduction to modern control theory. Pre: (3514, MATH 2214) or (ME 3514, MATH 2214H) or (ME 3514, MATH 2405H, MATH 2406H). (3H,3C)

#### 4524: INTRODUCTION TO ROBOTICS AND AUTOMATION

Automation, robot technology, kinematics, dynamics, trajectory planning, and control of two-dimensional and spatial robots; robot programming; design and simulation of robotic devices. Pre: (ECE 2574, STAT 4714) or (ME 3514, STAT 3704). (3H,3C)

#### 4534: LAND VEHICLE DYNAMICS

Analytical methods for land vehicle dynamics. Mechanics of pneumatic tires on pavement and steel wheels on rails. Vehicle stability, handling, response to random guideway and roadway irregularities, ride quality computation methods and standards, suspension design. Pre: 3514. (3H,3C)

#### 4544: AUTOMOTIVE ENGINEERING

Vehicle performance, drive train, suspension, steering, and brake systems. Steady state and transient conditions. Senior standing in Mechanical Engineering required. (3H,3C)

#### 4554: ADVANCED TECHNOLOGY FOR MOTOR VEHICLES

Energy use and environmental issues for motor vehicles: Emissions standards, fleet requirements, dynamometer testing, fuel economy, and vehicle performance. Alternative fuel vehicles: Characteristics and infrastructure of fuels, batteries, electric vehicles, and hybrid electric vehicles. Vehicle design: Modeling and simulation of vehicle energy use and performance, component sizing. Fuel cells for transportation. Heavy-duty vehicles and busses. Low mass vehicles and future vehicle technology. Pre: 3114 or 3124 or 3134. (3H,3C)

#### 4564: VEHICLE CONTROL

Overview of vehicle control systems and control algorithms for anti-lock braking, stability, road holding, lane departure, traction control, and tire pressure monitoring. Advanced driver assist systems and intelligent tire technology. Hands-on experience with hardware-in-the-loop systems. Mathematical modeling and simulation of vehicle control. Pre: 4504. (3H,3C)

#### 4614: MECHANICAL DESIGN II

Design of mechanical elements such as welded joints hydrodynamic bearings, spur gears, shafts, brakes. Alternative fatigue design methods, cumulative fatigue, mechanical design computer software. Pre: 3614. (3H,3C)

#### 4624: FINITE ELEMENT PRACTICE IN MECHANICAL DESIGN

Application of the finite element method to stress analysis problems in mechanical design. Modeling techniques, proper use of existing computer programs, interpreting of results, application to design modification. Pre: 3614. (3H,3C)

#### 4634: INTRODUCTION TO COMPUTER-AIDED DESIGN AND MANUFACTURING

Participants will study the computer-aided design and manufacturing of mechanical systems. A mechanical system will be designed including preliminary design, analysis, detail design, numerical control programming, and documentation. Applications programs will be written and interfaced to the CAD/CAM database. All assignments will be carried out on a CAD/CAM system. (2H,3L,3C)

#### 4644: INTRODUCTION TO 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. Programming skills required. (3H,3C)

#### 4664: INTRO GLOBAL COLL ENGR DESIGN

Participants will study topics fundamental to global collaborative engineering design, product 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 5664. Credit may only be received for one course. Pre: 2024, 4634. (3H,3C)

#### 4724: ENGINEERING ACOUSTICS

Basic acoustical theory and practice, acoustic terminology, measurement, transmission, and perception of sound, muffler design, noise control techniques. Pre: 3514. (3H,3C)

#### 4735,4736: MECHATRONICS

Electromechanical system modeling, control and applications. Design and building of electronic interfaces and controllers for mechanical devices, sensors, signal acquisition, filtering, and conditioning. Microcontroller-based closed-loop control and device communications. Sensor and actuator selection, installation, and application strategies are studied. A term design project is a key component to this course (for 4736). Pre: (ECE 3254, ME 3514) or (ECE 2004, ECE 2704) for 4735; 4735 for 4736. (3H,3C)

#### 4864: MICRO/NANO-ROBOTICS

Overview of Micro/Nano-robotic systems. Physics of reduced length scales (scaling effects in the physical parameters, surface forces, contact mechanics, and Micro/Nano-scale dynamical phenomena), Basics of Micro/Nano-manufacturing, microfabrication and soft lithography, Biomimetic design strategies for mobile micro-robots, Principle of transduction, material properties and characteristics of Micro/Nano-actuators (piezoelectric, shape-memory alloy, and a variety of MEMS and polymer actuators), Control requirements and challenges of Micro/Nano-actuators, Micro/Nano sensors for mobile microrobotic applications, Micro/Nano-manipulation (scanning probe microscopy, operation principles, designing experiments for nanoscale mechanical characterization of desired samples). Pre: MATH 2214, ME 3404, ME 3514, ESM 2204. (3H,3C)



4974: INDEPENDENT STUDY  
Variable credit course.

4974H: INDEPENDENT STUDY  
Honors Variable credit course.

4984: SPECIAL STUDY  
Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Variable credit course.

## Undergraduate Course Descriptions (NSEG)

### 3145-3146: FUNDAMENTALS OF NUCLEAR ENGR

Application of fundamental principles of neutron physics and reactor theory. Introduction to nuclear cross-section data, neutron scattering, nuclear fission, and diffusion theory. Examination of current and next generation nuclear power. Pre: MATH 2214 or MATH 2214H for 3145; 3145 or ME 3145 for 3146. (3H,3C)

### 3604: RADIATION DETECTION, PROTECTION AND SHIELDING

Radioactive decay, interaction of charged particles and photons with matter, methods of radiation detection and radiation dosimetry, counting statistics, radiation protection criteria and exposure limits, external radiation protection using time, distance and shielding. Pre: PHYS 2306. Co: MATH 2214. (3H,3C)

### 4204: NUCLEAR FUEL CYCLE

Uranium nuclear fuel cycle: radiation basics, uranium reserves, mining, conversion, enrichment, fuel manufacturing, in-core fuel management and refueling, spent fuel storage, reprocessing/recycling and final disposition as waste in a geologic repository. Introduction to nuclear safeguards and nonproliferation as applied to each step of cycle. Alternative fuel cycles. Co: 3146. (3H,3C)

### 4214: NUCLEAR POWER PLANT OPERATIONS

Emphasis on pressurized water reactor plant operations. Review of boiling water reactor operations. Detailed system functions and operation, reactor plant startup and shutdown procedures, reactor refueling, reactor plant safety analysis, reactor plant licensing, ethics and integrity in the nuclear industry. Pre: 3146. (3H,3C)

### 4424: REACTOR THERMAL HYDRAULICS

Fundamental processes of heat generation and transport in nuclear reactors: reactor coolant systems and components, heat generation and spatial distribution, heat transport by conduction and convection, single-phase flow, two-phase flow and boiling, critical heat flux. Pre: 3145. (3H,3C)

4974: INDEPENDENT STUDY  
Variable credit course.

4984: SPECIAL STUDY  
Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Honors Section Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Management

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[Entrepreneurship - New Venture Growth Minor](#)

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**Head:** Kevin D. Carlson

**Diggs Professor of Entrepreneurship:** S. E. Markham

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**Professors:** K. D. Carlson

**Associate Professors:** J. B. Arthur, D. J. Beal, W. J. Becker, A. T. Cobb, D. E. Hatfield, L. F. Tegarden, and R. D. Zimmerman

**Assistant Professors:** R. A. Hunt, M. T. Junkunc, P. Thakur Wernz, D. M. Townsend, and A. K. Ward Bartlett

**Professor of Practice:** S. J. Skripak

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**Business Leadership Center Director:** K. A. Carlson

**Business Diversity Center Director:** K. A. Carlson

**Apex Systems Center for Innovation and Entrepreneurship:** D. A. Maggard - Executive Director, S. J. Collins - Innovate Director, and M. T. Junkunc - Academic Director

Web: [www.management.pamplin.vt.edu](http://www.management.pamplin.vt.edu)



## Overview

Students choosing the Management Major are guided by world-class faculty to prepare for careers in the worlds' most successful organizations. Our courses build strong foundations in the fundamental management processes of planning, organizing, leading and controlling. To this we add advanced skill building in critical thinking, innovative problem solving, data analytics, ethical reasoning, persuasive communication, and interpersonal and team effectiveness. These skills position Management graduates for future success in a wide variety of high paying careers or as entrepreneurs.

Management majors add considerable value to the organizations that employ them. Great managers in any business act as force multipliers, increasing the output generated by the people they work with and the resources available to them. Management majors, their teams and their organizations do this by finding ways to help organizations work smarter. Our core curriculum helps students develop the awareness needed to identify new entrepreneurial opportunities, improve organizational processes, use analytics to support evidence-based decisions, and effectively manage projects in support of organizational change, but more importantly improvement.

Management majors take courses in one of three career centered options: Management Consulting and Analytics (MCA), Entrepreneurship, Innovation and Technology Management (EIT) or Human Resources Management (HRM). In addition, many Management majors choose to minor in Entrepreneurship, Leadership or International Business. They also participate in paid and for-credit internships, career-focused clubs and student-led extracurricular activities. An emphasis on developing employable skills is further supported by course-based and one-on-one strategic career planning.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Management Options

Each Management major is required to select and complete at least one 9 credit hour management option. These options are designed to provide students critical skills targeted toward potential future career paths.

### Option I: Entrepreneurship, Innovation & Technology Management

*This option prepares students to take an entrepreneurial approach to managing in any organizational context, ranging from large organizations to new startups. This option is suitable for students who intend to run their own businesses or who want to play a role in making existing businesses more entrepreneurial. Three additional courses are required for those students selecting this option.*

### Option II: Human Resource Management

*This option prepares general managers or individuals interested in a career in the human resources field with the knowledge and skills necessary to systematically manage people in order to achieve group and organizational objectives and to sustain organizational effectiveness. Three additional courses are required for those students selecting this option.*

### Option III: Management Consulting and Analysis

*The purpose of this option is to provide students the foundational skills necessary to succeed in careers in management consulting. Three additional courses are required for those students selecting this option.*

## Minors Offered Through the Department of Management

Students from majors across the university (including Management majors) may also earn any of two minors offered through the Department of Management. These minors are the Business Leadership minor and the Entrepreneurship-New Venture Growth minor.

### Business Leadership Minor

The Leadership minor provides a multi-disciplinary, experiential background in the history, values, skills and theory of leadership. It provides the student with the opportunity to tailor his/her leadership education and experience to personal and career needs.

The curriculum consists of eighteen (18) credit hours of study, including six (6) hours of electives and three (3) hours of experiential activity.

### Entrepreneurship - New Venture Growth Minor

The Entrepreneurship-New Venture Growth minor is intended to focus on the knowledge and skills to create new ventures and lead their early growth. The objective is to provide students with the knowledge and skills needed to convert ideas into business successes, particularly in the context of engineering and science-based technology commercialization.

The curriculum consists of eighteen (18) credit hours of study, including six(6) hours of business restricted electives, and six (6) hours of restricted electives.

## Undergraduate Course Descriptions (MGT)

1004: INTRODUCTION TO BUSINESS

Introduction to the role of the free enterprise system in society and economy. Study of the various business functions such as economic trends, accounting, finance, management, marketing, and production and operations. Analysis of these functions for programs of study and for career opportunities. Restricted to freshmen and sophomores. Partially duplicates MGT 1104, Foundations of Business. (2H,2C)

#### 1104: FOUNDATIONS OF BUSINESS

Introduces students to the free enterprise system and the various business functions, such as management, human resources, marketing, operations, accounting and finance, technology as well as to the different types of business such as manufacturing and service. Analyzes the various business functions to help improve understanding of career interests and opportunities, as well as to provide a basic understanding of how a company operates. Applies learning through a group project in which a micro-business is created and managed. (3H,3C)

#### 1935-1936: FUNDAMENTALS OF CADET PROFESSIONAL LEADERSHIP

1935: Foundational course of the Virginia Tech Corps of Cadets Citizen-Leader Program. Explores basic business etiquette and introduces the cadet to concepts of online professional identity, basic career preparation, resume writing, basic interviewing techniques and ways to create a healthy nutrition and physical fitness program. Includes a comprehensive physical fitness laboratory. Membership in the Corps of Cadets is required. 1936: Introduces methodologies for efficient and effective leadership, explores options for multiple career paths, basic business etiquette, opportunity to attend leadership conferences and field trips to local businesses. Prepares cadets for leadership positions in their sophomore year. Membership in the Corps of Cadets is required. (1H,2L,2C)

#### 1945-1946: FUNDAMENTALS OF CADET LEADERSHIP

Foundational course of the Virginia Tech Corps of Cadet Leader Development Program. Explores self-understanding, personality types, active and passive followership, leadership and ethical theories. A laboratory introduces freshmen cadets to academic success strategies. Membership in the Corps of Cadets is required. (1H,2L,2C)

#### 1984: SPECIAL STUDY

Variable credit course.

#### 2935-2936: CAREER PLANNING FOR CADETS

2935: Cadets in this class learn the basic of business networking, developing presentations, professional mentorship, personal finance, and investments, advanced nutrition and living a healthy lifestyle. A physical fitness laboratory complements the lecture. Membership in the Corps of Cadets is required. (1H,2L,2C)

#### 2944: MILITARY LEADERSHIP PRACTICUM

Progressive leadership education, training and development through readings, lectures, exercises and leadership positions within the Corps of Cadets. Emphasis of this course is on the day-to-day implementation of leadership strategies and tactics in a military environment. Topics include leadership theory and practice, honor and ethics education, and professional integrity. Exercises include small group discussion, leadership scenarios, and role-playing. Each cadet will perform at least one leadership position to include team leader, cadre, squad leader, platoon leader, company commander, or primary/special staff positions. May be taken up to 8 times. Pass/Fail only. (1H,1C)

#### 2945-2946: SMALL UNIT LEADERSHIP FOR CADETS

Prepares cadets for responsibilities as small unit leaders. Builds on the previous year's knowledge to focus on skills and knowledge necessary to lead small units. Introduces cadets to the importance of communication, includes basic counseling techniques, disciplinary actions, conflict resolution, cadet regulations and leadership case studies. Membership in the Corps of Cadets is required. (1H,1C)

#### 2954: BUSINESS STUDY ABROAD

This course provides students with an international business experience. It is only offered as part of a program outside of the United States. Students will learn from the structured educational experience developed by the faculty leader. This course is intended for students who want to take management-

related free electives. Pre: Instructor's consent and the completion of 24 semester hours with a minimum GPA of 3.0 or departmental consent. Variable credit course.

#### 2964: FIELD STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3014: CAREER PLANNING STRATEGY FOR MANAGEMENT MAJORS

Career success/satisfaction focus for Management Majors in the Pamplin College of Business. Behavior-based interviewing and assessment to identify behaviors that are critical to specific career roles. Mastery of these behaviors to improve search strategies and employment outcomes. Strategies for developing professional networks of individuals and organizations. Emphasizes progressive development of features profiles that help students differentiate themselves from competitors and position themselves for desired career options. Ethical pursuit of employment and negotiation of job offers. Pre: Junior standing. (3H,3C)

#### 3064: CORNERSTONES OF ENTREPRENEURSHIP AND INNOVATION

Provides a cornerstone foundation for the understanding of entrepreneurship and the business innovation process exposing students to fundamental business concepts applied and integrated in these arenas. An examination of value creation through entrepreneurship and the rudiments of new ventures are provided helping students develop an entrepreneurial frame of mind and perspective. (3H,3C)

#### 3074: SOCIAL ENTREPRENEURSHIP

Provides a foundation for how social entrepreneurs use and combine resources to pursue opportunities that lead to social change and/or address social needs. An examination of the nature of social entrepreneurship and its various practices is provided, helping students develop an entrepreneurial frame of mind and prepare them to act as effective leaders of social change. Pre: 3064. (3H,3C)

#### 3304: MANAGEMENT THEORY AND LEADERSHIP PRACTICE

This survey course introduces the student to a broad range of concepts, theories and practices important for a basic understanding of management. Topics also focus on the environment in which today's managers must effectively operate. Pre: Sophomore standing. (3H,3C)

#### 3314: INTERNATIONAL BUSINESS

The course provides a framework to show how a firm's international business operations can be analyzed, understood, and managed, including discussion of cultural, social, political, and economic aspects of doing business abroad. The main learning experience in the course is oriented toward effective decision-making in the face of unique challenges faced by managers in the international business environment, with the goal of improving critical, analytical and creative thinking skills in international business operations. Junior Standing Required. (3H,3C)

#### 3324: ORGANIZATION BEHAVIOR

This course examines the determinants and consequences of human behavior in formal organizations. Specific focus is on the individual, interpersonal, and group processes which underlie all the human dynamics. Co: 3304. (3H,3C)

#### 3334: MANAGING HUMAN RESOURCES

Examines the strategies, policies, and practices associated with effectively managing human resources. Designed to provide future managers with tools and techniques to acquire, develop, reward, and retain employees within the legal and social context of today's organizations. Emphasizes how managing human resources can contribute to organizational effectiveness in a variety of industrial and organizational settings. Pre: 3304. (3H,3C)

#### 3344: EMPLOYEE & LABOR RELATIONS

Examines employee and labor relations policies and practices from a legal, behavioral, social, and economic viewpoint. Covers the content and application of labor and employment laws. A focus on skills and knowledge associated with responding to employee organizing, negotiating employment contracts, and resolving employment disputes in private and public organizations. Union and non-union work

settings in the United States and selected other countries. Pre: 3304. (3H,3C)

#### 3424: HUMAN RESOURCE STAFFING AND DEVELOPMENT

Concentrates on the acquisition, deployment, and development of human resources within organizations. This course emphasizes the design and implementation of staffing, training, and development processes to achieve organizational objectives within social and economic constraints. Pre: 3304. (3H,3C)

#### 3444: MULTICULTURAL DIVERSITY IN ORGANIZATIONS

Examines the impact of multicultural diversity on the employee's work experience and on organizational processes/ performance. Shows how the ability to relate to people on every level is critical to business success. Discusses 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. Pre: Junior standing. (3H,3C)

#### 3464: DIVERSITY-RELATED INTERNSHIPS AND PROFESSIONAL DEVELOPMENT

Guided experience in a diverse work environment. Through a paid or unpaid internship, students will have the opportunity to experience diversity within an organization first hand while working on organizationally meaningful assignments in the classroom. Pass/fail only. Pass/Fail only. Pre: 3444. (1H,6L,3C)

#### 3604: MANAGERIAL ANALYTICS

Digital tools to analyze managerial data ranging from productivity data to large scale, organizational databases. Three themes: (1) analyzing and improving productivity using digital tools; (2) applying exploratory data tools; (3) improving organizational collaboration, analysis, and knowledge sharing using relational databases. Pre: ACIS 2504. Co: 3304. (3H,3C)

#### 3614: STRATEGY AND COMPETITION ANALYTICS

Develops concepts and techniques for analyzing and formulating strategy in a variety of business environments. Focuses on research, data, and analysis related to the key players in the environment from both a competitive and cooperative perspective. Basic frameworks for analysis include mapping the objectives and constraints of the players, and modeling the pattern of interaction among the players. Provides an in-depth exposure to the theory and tools of strategy analysis and practice in their management consulting application. Pre: ECON 2005, ACIS 2115, ACIS 2116, FIN 3104. Co: 3604. (3H,3C)

#### 3754: MANAGEMENT INTERNSHIP AND CAREER DEVELOPMENT

Guided experience in work environments and job search. Through unpaid internships, students have the opportunity to view the inner workings of businesses first hand while working on organizationally meaningful assignments. Class activities prepare students for conducting effective job searches. Pass/Fail only. Pre: 3304. (1H,6L,3C)

#### 3935-3936: ADVANCED PROFESSIONAL DEVELOPMENT FOR CADETS

3935: Cadets in this learn about the mentor-protégé relationship; resolving team conflicts; diversity in the workplace; standards of business conduct, dining etiquette; and maintaining a healthy lifestyle. A physical fitness laboratory compliments the lecture. Membership in the Corps of Cadets is required. (1H,2L,2C)

#### 3945-3946: CADET ORGANIZATIONAL LEADERSHIP

Prepares junior class cadets for responsibilities as senior sergeants. Builds on the previous year's knowledge of small unit leadership. Introduces cadets to decision making, writing decision papers/executive summaries, project management, public speaking, and refinement of their personal leadership philosophy. Membership in the Corps of Cadets is required. (1H,1C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 3964: FIELD STUDY

Variable credit course.

#### 4064: DEVELOPING ENTREPRENEURIAL VENTURES

Takes a cross-functional perspective on identifying and evaluating entrepreneurial opportunities,

developing new ventures, and pursuing new venture strategies to compete in the marketplace. Explores business potentials of new venture ideas, examines new venture's feasibility, and develops business planning tools for the venture. Pre: Senior Standing. Pre: 3064, (BIT 3414, FIN 3104) or (BIT 3414, MGT 3304) or (BIT 3414, MKTG 3104) or (FIN 3104, MGT 3304) or (FIN 3104, MKTG 3104) or (MGT 3304, MKTG 3104). (3H,3C)

#### 4074 (MKTG 4074): APPLIED SMALL BUSINESS CONSULTING

Application of accounting, finance, marketing, management, information technology, and management science concepts to small business cases. On-site consultation with existing firms. Through the experiential studies, students will explore the role of 'pro bono' work in the management field. Pre: Pamplin College of Business senior or graduate standing. Permission of instructor is required for students outside the Pamplin College of Business. Pre: 3304. (3H,3C)

#### 4084: MANAGEMENT CONSULTING

Hands-on application of accounting, finance, marketing, management, information technology, and project management to actual business clients through on-site consultation with start-up and existing businesses and non-profits. Through classroom instruction, instructor coaching, and experiential studies, students will use the skills they have learned over several semesters to explore the field of management consulting. For the Management major with senior standing in the Management Consulting Option. Pre: 3304. (3H,3C)

#### 4094 (ENGE 4094) (IDS 4094): MANAGING TECHNOLOGY COMMERCIALIZATION

How technology-based innovations, innovations developed through science or engineering expertise, are leveraged from the innovative idea or concept to successful commercial products. Examines the frames that guide the technology commercialization process and applies these frames by using cross-functional teams to investigate a commercialization project from opportunity scanning to exploitation. (3H,3C)

#### 4314: INTERNATIONAL MANAGEMENT

The course is designed to provide the student with familiarity concerning the unique problems, characteristics, and demands that face multinational managers and the international business community. Junior standing required. (3H,3C)

#### 4324 (PHIL 4324): BUSINESS AND PROFESSIONAL ETHICS

An inquiry into the fundamental norms of conduct in business and other professions and their justification in relation to the most important ethical theories. Special attention will be given to moral problems such as the ethics of hiring and firing, bribery, and professional responsibility to society. (3H,3C)

#### 4334: ETHICAL LEADERSHIP AND CORPORATE SOCIAL RESPONSIBILITY

The leadership role of managers in promoting ethics and corporate social responsibility in business today. Consideration of business-society issues such as environmental pollution, employee rights and responsibilities, discrimination/affirmative action, and the activities of multinational corporations. These issues will be examined through the conceptual frameworks of business ethics and corporate social responsibility. Pre: 3304. (3H,3C)

#### 4344: PRODUCTIVITY AND QUALITY LEADERSHIP

This course provides an introduction to leadership in the context of productivity and quality improvement. It focuses on understanding the concepts and skills associated with contemporary management strategies and systems. This course requires active student involvement and emphasizes participative leadership skills, data collection, qualitative problem solving, and communication processes. For Management majors only. Senior standing required. Pre: 3304, 3324, 3604, BIT 3414. (3H,3C)

#### 4354: LEADERSHIP: ADVANCES IN SKILLS AND CONCEPTS

This cornerstone course provides cutting-edge experiences, skills, and knowledge in leadership for students in the leadership minor. 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: senior standing. Pre: 3304. (3H,3C)



#### 4394: STRATEGIC MANAGEMENT

Senior-level capstone course to formulate and implement strategies to create and sustain competitive advantage. Emphasis on developing pragmatic and action-oriented general management skills that integrate across functional areas of the organization. Utilize various tools, concepts, and analytical framework to define and analyze strategic problems. Revisits business principles and practices covered in basic business courses. Pre: Senior standing. Pre: 3304, (MKTG 3104 or MKTG 3104H), FIN 3104, BIT 3414. Co: FIN 3054. (3H,3C)

#### 4414: COMPENSATION AND PERFORMANCE MANAGEMENT

This course provides the knowledge and skills required by managers to design and implement comprehensive compensation and performance management systems in public and private organizations. Topics include development of compensation strategy, internal pay structure, determination of pay level through wage surveys, evaluating job performance, rewarding individuals and groups, and administering employee benefits. Pre: 3304. (3H,3C)

#### 4864: WI UNDERGRADUATE RESEARCH

Variable credit course.

#### 4874: WI INDEPENDENT STUDY

Variable credit course.

#### 4935-4936: CADET CITIZEN LEADER PRACTICUM

4935: Students in the class learn practical strategies for leading teams to plan execute a project; project writing; applied dining etiquette; being a mentor to others, leadership through service learning and living a healthy lifestyle. A physical fitness laboratory compliments the lecture. Membership in the Corps of Cadets is required. (1H,2L,2C)

#### 4944: LEADING IN YOUR PROFESSION

Examines the skills and knowledge necessary to succeed in a responsible role of leadership when beginning one's career. It is a capstone course that draws on the leadership training and experience cadets have accumulated during their first three years in the Corps of Cadets. Senior standing in the Corps of Cadets required. Course may be taken twice for credit. The pre-requisite requirement is such that a student must take the pre-requisite twice before enrolling in this course. Pre: 2944. (1H,1C)

#### 4945-4946: EXECUTIVE LEADERSHIP FOR CADETS

Examines executive level leadership. It explores executive decision making, constraint theory and problem solving in both the military and civilian career fields. Senior standing in the Corps of Cadets is required. (1H,1C)

#### 4954: STUDY ABROAD

Variable credit course.

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors section Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Mining and Minerals Engineering

[Overview](#)

[Degree Requirements](#)

[Undergraduate Course Descriptions \(MINE\)](#)

**Head:** E.C. Westman

**University Distinguished Professor and Nicholas T. Camicia Professor:** R.H. Yoon

**Stonie Barker Professor:** M. E. Karmis

**E. Morgan Massey Professor:** G. H. Luttrell

**Professor:** E.C. Westman

**Associate Professors:** M. G. Karfakis and K.D. Luxbacher

**Assistant Professors:** C. Cheng, E.S. Gilliland, B. Nojabaei, N. Ripepi, and E.A. Sarver

**Adjunct Professor:** J.A. Herbst

Web: [www.mining.vt.edu](http://www.mining.vt.edu)

## Overview

The Department of Mining and Minerals Engineering offers an engineering program containing aspects of mineral science, engineering, and technology that is professionally related to the minerals industry. Graduates of this program find domestic and international employment opportunities with hardrock, coal, industrial minerals, and construction aggregates producers, as well as with government agencies and equipment vendors.

The mission of the department is to produce high quality, rigorously trained mining engineers, whose background and education reflect the current level of technology and thought of the profession, and who can enter directly into engineering practice or, alternatively, graduate school for further study. Specifically, the Department of Mining and Minerals Engineering seeks, as its educational objectives, to prepare alumni within a few years of graduation to possess:

- the intellectual ability to critically assess and tackle any engineering problem they may encounter;
- the communication skills to communicate technical information to a variety of audiences including technically trained supervisors and subordinates as well as non-technical members of the work force and the general public;
- the leadership and team building skills to lead projects and function as entry-level managers as well as work productively as members of a team;
- an understanding of the practical aspects of the mining industry and an appreciation for mining as a business; and
- an awareness of societal issues and how these issues affect their role as future professional engineers working for the general benefit of society.

The mining engineering curriculum utilizes the basic and engineering sciences to develop the various areas of activity of the mining engineer: mineral exploration, evaluation, development, extraction, mineral processing, conservation, protection of the environment, and mineral economics. Course work in these areas provides a unique background for engineering and management positions in industry and government, as well as for continuation of specialized graduate studies.

Intrinsic to the curriculum is the development of a meaningful, major engineering design experience that builds upon the fundamental concepts of mathematics, basic sciences, the humanities and social sciences, engineering topics, and communication skills. This design experience is stressed within the major and grows with the development and progression of the student. Ethical, social, safety, economic, and environmental considerations are emphasized in the design experience throughout many courses, including the capstone senior design course. Finally, the major engineering design experience is a focal point of the mining engineering curriculum and is consistent with the objectives and goals of the program.

The program has an emphasis on the application of computers to mining and minerals processing operations. Furthermore, it exposes students to laboratory courses which focus on conducting experiments, understanding the principles involved in each experiment, and analyzing and interpreting experimental data. Information on the mission, goals, and curriculum of the program is continuously updated on the departmental website.

The Cooperative Education Program, as well as opportunities for financial support in the form of scholarships, loans, awards, and summer employment, are available to undergraduate and graduate students. Graduate programs are available leading to the M.S., M. Eng., and Ph.D.

The B.S. degree program in Mining Engineering is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

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## Undergraduate Course Descriptions (MINE)

2504: INTRODUCTION TO MINING ENGINEERING

Introductory course covering the complete field of Mining and Minerals Engineering with special emphasis on the evolution of discrete mining systems, interaction of mining with the environment and the inter-relationship of Mining and Minerals Engineering with other disciplines. I (3H,3C)

#### 2514: MINING SURVEYING

Specialized principles of field surveying as applied to the delineation of mineral deposits and the design and monitoring of surface and underground mining operations. Introduction to surveying instruments, field techniques, computation procedures and mapping. Pre: (MATH 1224 or MATH 2204 or MATH 2204H), (ENGE 1024 or ENGE 1215). (3L,1C) II.

#### 2524: ELEMENTS OF MINE DESIGN

Basic concepts used in the modeling and design of mining systems including basic statistical concepts, sampling, geological and geostatistical modeling of ore bodies, ore reserve estimation, and selection of basic mine development methods. Pre: 2504, GEOS 1004. (2H,3L,3C) II.

#### 2534: MINE SURVEYING AND MAPPING

Specialized principles of field surveying and mapping as applied to the delineation of mineral deposits and the design and monitoring of surface and underground mining operations. Introduction to modern surveying instruments, field techniques, and computational procedures. Basic digital mine mapping to include standard mine symbols and representation of surface and underground mine workings. Partially duplicates ENGE 2824. Pre: (ENGE 1104 or ENGE 1114), (MATH 1224 or MATH 2204 or MATH 2204H). (2H,3L,3C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3504: ROCK MECHANICS AND GROUND CONTROL

Properties and behavior of geologic materials and masses and their classifications and ratings. Design principles of structures founded on and in rocks and basic aspects of ground control. I Pre: ESM 2204, GEOS 1004, MINE 2504. (3H,3C)

#### 3514: ROCK MECHANICS LABORATORY

Laboratory techniques used in the determination of geologic materials properties and behavior. Determination of rock index properties, strengths, failure criterion and mechanical behavior. I Co: 3504. (3L,1C)

#### 3524: EXCAVATION ENGINEERING

Rock fragmentation for excavation; drilling fragmentation, rock drilling systems; blasting fragmentation, types and properties of commercial explosives and accessories, system of initiation, design of blasting rounds, applications in mining and construction, structural damage criteria, overbreak control, safe practice and regulations; fragmentation by excavation machines; excavation system selection and design. I Pre: GEOS 1004, ESM 2204, MINE 2504. (3H,3C)

#### 3534: MINERAL PROCESSING

Principles of processing ores to recover valuable minerals. Basics of mineral processing including sampling theory, material balancing, slurry calculations, grade-recovery relationships, particle size analysis, process control. Unit operations including crushing, grinding and size separation. Applications to coal cleaning and crushed stone production. I Pre: 2504. (2H,2C)

#### 3544: MINERAL PROCESSING LABORATORY

Laboratory investigations of the unit operations and principles of mineral processing including ore preparation (size reduction, mineral liberation, and classification) and mineral recovery (froth flotation, electrostatic separation, magnetic separation, and solid-liquid separation). Pre: 3534. Co: 3554. (3L,1C) II.

#### 3554: RESOURCE RECOVERY

Techniques for the separation and concentration of primary and secondary resources. Mineral concentration and waste recycling. Solid/solid concentration including gravity concentration, dense medium separation, froth floatation, magnetic separation and high tension separation. Solid/liquid separation including sedimentation/clarification, filtration and thermal drying. Overview of hydrometallurgical processing including leaching, solvent extraction and electrowinning. Pre: 3534, CHEM 1035. (2H,2C) II.

#### 3564: UNDERGROUND MINE DESIGN

Design fundamentals of mining systems and stope development for tabular and massive underground mineral deposits. Equipment selection and application, permitting, cost analysis and production simulation. Pre: 2524, 3504. (3H,3C) II.

#### 3574: SURFACE MINE AND QUARRY DESIGN

Surface mining methods, and their selection; mine planning and design; excavation, haulage and ancillary systems; equipment selection and maintenance; impoundment and piles design; mine closure/reclamation. Pre: 2524, 3524. (3H,3C) II.

#### 3584: VENTILATION ENGINEERING

Subsurface ventilation systems. Ventilation planning and design, laws of airflow, airway resistance. Ventilation surveys, network analysis, ventilation economics. Ventilation software. Fan types, impeller theory, fan laws and testing. Mine ventilation thermodynamics. Pre: 2504, ESM 3024. (2H,3L,3C) II.

#### 4504: MATERIALS HANDLING AND POWER SYSTEMS

Principles of materials handling, fluid power and electrical power systems for surface and underground mining operations. Engineering analysis and design of secondary haulage operations (belt conveyors, hoists, trucks, railways), fluid power systems (hydraulics, pumps, piping networks, compressors, pneumatic equipment). Electrical systems (electrical machinery, distribution networks, controls), and other ancillary systems required to support mining operations. Assessment of equipment reliability and development of preventive maintenance programs. Pre: ESM 3024. Co: ECE 3054. (3H,3C)

#### 4514: HEALTH, SAFETY AND RISK MANAGEMENT

Study of risk analysis; mine legislation; mine gases, their occurrence, and physiological effects; methane emissions; dust classification, monitoring, and control; heat and humidity; psychrometry; physiological effects; climatic simulation; radiation monitoring and control; equipment hazards; noise; illumination; personal health and safety; fires and explosions; disaster management. I Pre: 3564 or 3574. (3H,3C)

#### 4524: PROJECT ENGINEERING AND MINE MANAGEMENT

Introduction to theory and practice of project engineering and management. Estimation of capital and operating expenditures. Cash flow development, worth evaluation, comparison of alternatives, taxation/depreciation and optimization. Principles of financial management, accounting and resource utilization. Topical seminars by industrial representatives. I Pre: 3564 or 3574. (3H,3C)

#### 4535-4536: SENIOR DESIGN PROJECT

Investigation of a significant design problem in mining engineering under the supervision of a staff member. Periodic progress reports and submission of a comprehensive final design project including detailed drawings, engineering calculations, economic feasibility, and environmental impacts. I Pre: 3564 or 3574 for 4535; 4535 for 4536. Co: 4524 for 4535. 4535: (3L,1C) 4536: (6L,2C)

#### 4544: MINE RECLAMATION AND ENVIRONMENTAL MANAGEMENT

Statutory and regulatory controls on the mining environment. Air, water and land pollutants, standards, monitoring systems, and prevention and control techniques. Unique environmental issues, Surface Mine Conservation and Reclamation Act (SMCRA), endangered species, environmental impact statements, permitting, environmental audits and torts. Pre: 3574. (3H,3C) II.

#### 4554: MINING ENGINEERING LEADERSHIP SEMINAR

Invited speakers, short-courses and workshops on subjects related to leadership issues in mining and minerals engineering. Technology and design; mining finances and marketing; management and

business concerns; labor relations and leadership; team building, motivation, and communications; problem solving and performance measurements; environmental issues; permitting and regulatory requirements. Senior standing required. (3L,1C) II.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course. X-grade allowed.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Marketing

[Overview](#)

[Requirements](#)

[Undergraduate Course Descriptions \(MKTG\)](#)

**Head:** Paul M. Herr

**Robert O. Goodykoontz Professor of Marketing:** D. Brinberg  
**Virginia-Carolinas Professor of Purchasing Management and Professor of Marketing:** P.M. Herr

**R. B. Pamplin Professor of Marketing:** K. Nakamoto  
**Professor and Real Estate Fellow:** M.J. Sirgy

**Associate Professors:** R. Bagchi, E. Coupey, M. Pandelaere, and K. Weaver

**Assistant Professors:** J. Jiang, F. May, and A. S. Chaxel

**Visiting Assistant Professor:** J. Sundie

**Emeritus Faculty:** N. Klein, J. E. Littlefield, M. M. Bird, and J. E. Keith

**Professor of Practice:** B. Collins

**Associate Processor of Practice:** D. Wertalik

**Advising:** Pamplin College of Business, Undergraduate Programs Advising Center is located at 1046 Pamplin Hall. Students may schedule appointments by calling (540) 231-6602.

Web: [www.marketing.pamplin.vt.edu](http://www.marketing.pamplin.vt.edu)



## Overview

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, assign effective price levels, create promotional strategies, and develop the best distribution plans to guarantee that products reach the final consumer. Marketing also plays a crucial role in managing the efficient flow of goods and services from businesses to businesses. 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. Marketing by manufacturing firms is well-known. Service industries such as banking and health care, however, are increasingly relying on marketing to improve service quality and delivery. Non-profit organizations, such as Habitat for Humanity and the American Red Cross, also use marketing to deliver social goods and services. All of these organizations benefit when they are able to use marketing concepts and tools to better understand their clients and design unique offerings that can meet their clients' needs.

The undergraduate program in marketing management is designed to offer the student a broad business education with an emphasis on professional training for development of marketing strategies and managing marketing operations. Virginia Tech Marketing graduates pursue a range of careers. They take jobs in marketing management, sales, advertising, retailing, and consulting positions in companies small and large. The curriculum is designed to provide core skills in marketing and to support this broad range of potential career interests.

In addition to the undergraduate program, the faculty in marketing management offer a master's and a doctoral degree for those students interested in more technical positions, such as marketing research; more rapid promotion with certain employers; or positions in higher education.

In addition to the undergraduate program, the faculty in marketing management offer a master's and a doctoral degree for those students interested in more technical positions, such as marketing research; more rapid promotion with certain employers; or positions in higher education.

The department participates in the Cooperative Education Program in which qualified students may alternate semesters of study with semesters of professional employment.

The Marketing Department currently offers two degree options: Marketing- no concentration and



Marketing- Sales concentration. In addition to the major, Marketing offers a minor in Professional Sales to non-Marketing majors within the College of Business only.

The Professional Sales concentration and minor provide students with the knowledge and skills necessary to successfully enter the field of professional sales. Students will learn the necessary knowledge and skills needed to compete successfully in the respective field.

## Requirements

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

### Minor Requirements

The requirements to earn a minor in Professional Sales can be found on its checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (MKTG)

### 2954: BUSINESS STUDY ABROAD

This course provides students with an international business experience. It is only offered as part of a program outside of the United States. Students will learn from the structured educational experience developed by the faculty leader. This course is intended for students who want to develop marketing-related free electives. Pre: Instructor's consent and the completion of 24 semester hours with a minimum GPA of 3.0 or departmental consent. Variable credit course.

### 2964: FIELD STUDY

Variable credit course.

### 2964H: FIELD STUDY

Honors section. Variable credit course.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 3104: MARKETING MANAGEMENT

Study of the marketing process from a macro and management viewpoint. The macro viewpoint includes the role of marketing in society. The management viewpoint includes the product, distribution, promotional, and pricing decisions. Junior standing required. (3H,3C)

### 3104H: MARKETING MANAGEMENT

(3H,3C)

### 3504: ADVERTISING

Survey of advertising principles and its applications. The course covers advertising history, the impact of advertising on society, and ethical and regulatory issues. The process of creating and placing advertising

is explored including advertising objectives, budgeting, media planning and mix, creative objectives and strategy, copy execution and production, and copy testing. Junior standing required. Pre: 3104 or 3104H. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4144 (CHE 4144): BUSINESS AND MARKETING STRATEGIES FOR THE PROCESS INDUSTRIES

Business strategies and industrial marketing concepts, and their application in the chemical, pharmaceutical and related process industries. The course is designed for engineers and other students planning a career in the process industries. Junior standing required. Pre: ECON 2005. (3H,3C)

#### 4154: MARKETING RESEARCH

This course is a study of the scientific process of problem solving in a marketing context. It includes concepts of problem definition, hypotheses generation, questionnaire development, research design, implementation, analysis, and interpretation of statistical findings. Junior standing required. Pre: (BIT 2405 or STAT 3005), BIT 2406. Co: 3104. (3H,3C)

#### 4204: CONSUMER BEHAVIOR

An integrated analysis of individual and environmental influences on consumer decision making, purchase, and consumption behaviors with strong emphasis on implications for developing, executing, and assessing marketing strategy. Junior standing required. Pre: 3104 or 3104H. (3H,3C)

#### 4204H: CONSUMER BEHAVIOR

An integrated analysis of individual and environmental influences on consumer decision making, purchase, and consumption behaviors with strong emphasis on implications for developing, executing, and assessing marketing strategy. Junior standing required. Honors section Pre: 3104 or 3104H. (3H,3C)

#### 4254: PRODUCT AND PRICE MANAGEMENT

Strategic product planning and new product development are discussed within the context of marketing management. Economic, financial, legal, and marketing principles are integrated to analyze pricing decisions. Behavioral implications of pricing also are considered. Relationships between product and price management address. Junior standing required. Pre: 3104 or 3104H. (3H,3C)

#### 4264: ANALYTICS FOR MARKETING

Integrates conceptual and quantitative aspects of marketing. Provides concentrated emphasis on the role of analytical and computer models to enhance marketing decision making. Emphasis on managerial decision making in key areas, including segmentation and targeting, positioning, forecasting, new product design, forecasting and pricing. Role of consumer perceptions and behaviors on decision making. Hands-on experience with model building and using analytical tools. Pre: 4154. (3H,3C)

#### 4304: MARKETING COMMUNICATIONS

Theory and application of an organization's marketing communications function. Content will include developing a marketing plan, setting communication goals, developing message strategy, implementing the strategy using promotional mix variables, planning media, and determining the communication budget. Junior standing required. Pre: (3104 or 3104H), 4204. (3H,3C)

#### 4354: MARKETING CHANNELS AND LOGISTICS

Management of the firm's distribution function. Study of the structure, functions, interactions, and activities of marketing channels. Analysis and development of integrated physical distribution and logistics systems for the firm. Junior standing required. Pre: (3104 or 3104H), 4204, (BIT 2405 or STAT 3005), BIT 2406. (3H,3C)

#### 4404: FIELD PRACTICUM IN MARKETING

Application of marketing concepts and theories to a specific business concept. On-site performance of marketing activities and a written analysis of the firm's marketing strategy and execution. Junior Standing Pre: 3104 or 3104H. (3H,3C)

#### 4454: SALES FORCE MANAGEMENT

Integration of behavioral research to provide an understanding of the role of the salesperson within the sales organization and in relation to the buyers. Personal selling examines the dyadic interaction between buyer and seller. Managing the sales force covers planning, organizing, directing, and controlling the activities of the sales personnel. Junior standing required. Pre: 4554, (3104 or 3104H), 4204. (3H,3C)

#### 4554: RELATIONSHIPS AMONG BUYERS AND SELLERS

Management of relationships between buyers and sellers among marketing organizations. Organizational buying, personal selling, and relationship marketing. The buying center and buying roles, the buying situation, the purchasing role, the sales process, personal selling approaches, negotiation, power and dependence, conflict resolution, and relational exchange. Pre: 3104 or 3104H. Co: 4204. (3H,3C)

#### 4604: RETAIL MANAGEMENT

Analysis of managerial problems in retailing establishments. Focus is on operational problems, retail store organization, location analysis, buying, selling, sales promotion, and merchandise handling. Junior standing required. Pre: 3104 or 3104H. (3H,3C)

#### 4644: MARKETING, SOCIETY AND THE PUBLIC INTEREST

The impact of marketing on society from a multi-disciplinary and multi-stakeholder perspective. Marketing's role in solving societal problems is explored. Topics include at-risk market segments, controversial products and practices, and issues of social justice. Pre: 3104 or 3104H. (3H,3C)

#### 4704: INTERNATIONAL MARKETING

Assessing international markets, comparing marketing systems; management of international marketing operations; focusing on distribution, promotional, and pricing problems faced by firms engaging in world trade. Junior standing required. Pre: 3104 or 3104H. (3H,3C)

#### 4734: REAL ESTATE MARKETING

This course extends the fundamental concepts of marketing into the study and practice of real estate. The course is concerned with the topics of demographic analysis, market information systems, market research, and marketing strategy of residential and commercial real estate, with particular emphasis on the important area of real estate personal selling. Junior standing required. Pre: 3104 or 3104H. (3H,3C)

#### 4754: STRATEGIC MARKETING

An integrative course in marketing policy and strategy, employing comprehensive case problems in the formulation of marketing action programs and business policy. Senior standing required. Any one of the following Marketing prerequisites--4304, 4354, 4554--may be taken concurrently with 4754. Pre: (3104 or 3104H), 4154, (4204 or 4204H). (3H,3C)

#### 4754H: STATEGIC MARKETING

An integrative course in marketing policy and strategy, employing comprehensive case problems in the formulation of marketing action programs and business policy. Senior standing required. Any one of the following Marketing prerequisites - 4304, 4354, 4554 - may be taken concurrently with 4754H Pre: (3104 or 3104H), 4154, (4204 or 4204H). (3H,3C)

#### 4774: ADVANCED PROFESSIONAL SELLING

Advanced theory and practice of professional selling with primary focus on the professional sales process, analysis of associated strategic and ethical issues, and acquisition of critical skills required of successful salespeople. Builds on foundation created in Buyer/Seller Relationship (MKTG 4554) to expand knowledge and skills of students considering career in professional sales. Pre: 4554, 4204, (3104 or 3104H). (3H,3C)

#### 4954: STUDY ABROAD

Variable credit course.

#### 4964: FIELD STUDY

Variable credit course.

#### 4964H: FIELD STUDY

Honors section. Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: HONORS UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Naval ROTC

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### Overview

[Four-Year National Scholarship Program](#)

[Four-Year College Program](#)

[Two- and Three-Year NSTC Controlled Scholarship Program](#)

[Requirements for All Candidates](#)

[Emerging Leader Scholarship Program](#)

[Leadership Minor](#)

[Undergraduate Course Descriptions \(MN\)](#)

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**Head:** Michael A. Fisher, CAPT, USN

**Professor:** M. A. Fisher

**Associate Professor:** J. W. Burkette

**Assistant Professors:** A. J. Martin, L. A. Deprisco, R. M. Knapp, C. M. Fearon, and M. L. May

Web: [www.usnavy.vt.edu](http://www.usnavy.vt.edu)

## Overview

The Naval Reserve Officers Training Corps (NROTC) offers eligible young men and women the opportunity to earn commissions in the Navy or Marine Corps. NROTC midshipmen are required to complete the naval science curriculum and attend weekly laboratory sessions. During summer vacations, midshipmen participate in active duty at-sea or shore-based training facilities for periods of approximately four weeks. Students may enroll in the NROTC Program at the start of college or at the beginning of their sophomore year. Two-, three-, and four-year scholarships may be available for those who demonstrate outstanding potential. Upon completion of university degree requirements and the naval science program, qualified midshipmen are commissioned as Ensigns in the Navy (Navy-option) or Second Lieutenants in

the Marine Corps (Marine-option).

Students may join NROTC through any one of the following four programs.

## Four-Year National Scholarship Program

Students enter the NROTC Four-Year Scholarship Program through national competition and are appointed Midshipmen in the Naval Reserve. While enrolled the government provides tuition, fees, uniform allowance, book allowance, and a monthly allowance. Students complete required naval science courses and participate in three summer training periods of approximately four weeks each. Upon graduation midshipmen are commissioned with an obligation to serve on active duty for at least five years.

## Four-Year College Program

Students are enrolled in the Four-Year College Program upon acceptance by the Professor of Naval Science. Naval Science textbooks and a uniform allowance are provided and, during their junior and senior years if accepted for advanced standing, College Program students receive a monthly allowance. College Program students are obligated to complete the prescribed naval science curriculum, attend one summer at-sea training period, accept a commission in the Naval Reserve or Marine Corps Reserve upon graduation, and serve on active duty after graduation a minimum of three years for Navy personnel and 3-- 1/2 years for the Marine Corps.

## Two- and Three-Year NSTC Controlled Scholarship Program

Students enrolled in the NROTC College Program and in good standing may be nominated by the Commanding Officer/Professor of Naval Science for a limited number of two- and three-year scholarships awarded by the Naval Service Training Command. If selected and found medically qualified, these students receive the same benefits and incur the same obligations as the Four-Year Scholarship Program.

## Requirements for All Candidates

Qualifications for acceptable candidates for the Scholarship Programs or the College Programs include: U.S. citizenship; membership in the Virginia Tech Corps of Cadets; fulfillment of physical examination requirements; and willingness to participate in required summer training periods and to accept the appropriate commission in the Navy, Marine Corps, Naval Reserve, or Marine Corps Reserve when offered.

If not included in the requirements of their majors or the Curriculum for Liberal Education and college core curriculum, NROTC Navy-option scholarship students must complete the following: one year of college calculus through differential and integral calculus of one real variable; one year of calculus-based physics; one semester of American military affairs or national security policy; one year of English; and an Area 2 class approved by your NROTC advisor.

During NROTC enrollment, each midshipman will be required to pass semiannual physical fitness tests and to qualify as a swimmer before going on summer cruise.

## Emerging Leader Scholarship Program

The University, in conjunction with the Virginia Tech Corps of Cadets Alumni Association, is offering a scholarship to incoming freshmen who are enrolled in an ROTC program and become members of the Corps of Cadets. Contact the Virginia Tech Corps of Cadets for more information.

## Leadership Minor

Students participating in the Virginia Tech Corps of Cadets are eligible for a minor in leadership based on the training and experience they gain while a member of the Corps. Students who complete one of the three ROTC programs may qualify to receive the minor when they complete their bachelor's degree. Contact the Center for Leader Development for more information.

## Undergraduate Course Descriptions (MN)

### 1004: INTRODUCTION TO NAVAL SCIENCE

Naval profession and concept of seapower. Missions and organization of Navy and Marine Corps. Overview of naval concerns, customs, traditions, seamanship, regulations, and military justice. I (3H,3C)

### 1104: NAVAL SHIPS SYSTEMS I: ENGINEERING

Ship characteristics and types. Includes ship design, hydrodynamic forces, stability, main propulsion, electrical and auxiliary systems, interior communications, ship control, and damage control. One semester of college level science required. Pre: 1004. (3H,3C) I,II.

### 2004: NAVAL SHIPS SYSTEMS II: WEAPONS

Theory and employment of naval weapons systems. Includes threat detection, evaluation, weapon selection, delivery systems, guidance, and warhead design. Elements of command, control, and communications. (3H,3C) I,II.

### 2104: SEAPOWER AND MARITIME AFFAIRS

A survey of naval history from the American Revolution to the present with emphasis on major developments in strategy, tactics, and technology. Discussion of the geopolitical theory of Alfred Thayer Mahan. Explores present concerns in seapower and maritime affairs, including the economic and political dimensions of ocean commerce, the Law of the Sea, a comparison of U.S. and Soviet maritime strategies, and current naval affairs. (3H,3C) II.

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3005-3006: NAVIGATION AND NAVAL OPERATIONS

3005: An in-depth study of the theory and practice of piloting and introduction to celestial navigation. Students develop practical skills in the use of charts, visual and electronic aids. A study of the International Rules of the Nautical Road. 3006: Relative motion, vector-analysis theory, and ship employment. Includes an introduction to naval operations, ship characteristics, shiphandling, and afloat communications. I (3H,3C)

### 3204: EVOLUTION OF WARFARE

Development of warfare focusing on impact of major military theorists, strategists, and technicians. Ancient times to present. I Pre: 2104. (3H,3C)

### 4005-4006: LEADERSHIP AND MANAGEMENT/ETHICS

Advanced-level study of leadership and management theory, including planning, organizing, communication, decision-making, and individual and group behavior. Explores major behavioral theories; practical applications involve experiential exercises, case studies, and laboratory discussions. 4006: Ethics and management in the Navy. Includes study of professionalism and ethics, human resources development, counseling, military law, personnel evaluation, administration, and material management. Pre: SOC 1004. (3H,3C) I,II.

### 4204: AMPHIBIOUS WARFARE

Historical survey of the development of amphibious doctrine and the conduct of amphibious operations.

Emphasis is on amphibious operations in World War II. Present day potential and limitations on amphibious operations are explored. I (3H,3C)

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course. II.





# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Army ROTC

[Overview](#)

[Minor in Leadership Studies](#)

[Undergraduate Course Descriptions \(MS\)](#)

**Head:** Kevin W. Milton, Col., U.S. Army

**Professor:** K.W. Milton

**Assistant Professors:** A. Hascher, D. Haeffner, M. Wright, and S. Ray

**Advisor:** (540) 231-6401

Web: [www.armyrotc.vt.edu](http://www.armyrotc.vt.edu)

## Overview

The Department of Military Science provides a program of leadership development which prepares college men and women for service as officers in the United States Army. After graduation, they serve as commissioned officers on active duty, or as officers in reserve forces units. To accomplish this, the department:

- Prepares cadets to be commissioned as Second Lieutenants through a curriculum which develops leadership skills, and provides opportunities to utilize these skills in a variety of practical applications.
- Provides an understanding of how to lead and influence small organizations, with a strong emphasis on personal integrity, critical thinking, ethical decision making, goal setting, and mission accomplishment.
- Offers adventure training, such as rappelling, land-navigation, marksmanship, and, for selected students, airborne, air assault, combat diver training. Army sponsored international programs for cultural awareness and language training as well as internships with active army units and federal

agencies worldwide are also offered during the summer.

- In conjunction with the Virginia Tech Corps of Cadets, provides programs and experiences which increase self-confidence, self-discipline, physical stamina, poise, and other attributes essential to the development of a leader--one who is prepared to serve the nation or the commonwealth both in or out of uniform.

The curriculum and leader development programs of the Department of Military Science are mentally and physically challenging. Cadets learn individual soldier skills and undergo physical conditioning, beginning in the freshman year. On-campus instruction is done both in the classroom and in the field environment. Lab training and leadership development exercises expand the general knowledge of cadets and provide opportunities for practical leadership experience. Summer leadership training occurs after either the freshman or sophomore year as well as between the junior and senior years at Fort Knox, Kentucky.

Army ROTC offers the conventional four-year program where a student enters as a freshman. A three-year program for sophomores is also available. Additionally, a two-year program is offered for juniors and graduate students. Placement credit may be awarded to students with ROTC or JROTC experience, students currently serving in the Army Reserve or National Guard, those who have had active military service, or those who volunteer for summer training at Fort Knox, Kentucky.

Scholarships covering full tuition and fees are available for entering freshman through a High School National Army ROTC Scholarship Board process. Applications for these scholarships are available on-line at [www.goarmy.com/rotc](http://www.goarmy.com/rotc). Otherwise, Cadets enrolled in Army ROTC can compete for Campus Based scholarships through the department's Recruiting Operations Officer. All contracted Cadets (scholarship or non-scholarship) enrolled in the junior and senior years of ROTC are paid a tax-free stipend of \$450.00 for ten months during their junior year and \$500 for ten months during their senior year for a total of \$9,500.00. Membership in the Virginia Tech Corps of Cadets is a pre-requisite for all ROTC classes. The cost of cadet uniforms is paid by a special Army uniform allowance provided to each enrolled cadet.

## Minor in Leadership Studies

Satisfactory completion of the 20-credit military science curriculum may qualify each cadet for a minor in leadership studies. Virginia Tech is the first land-grant university in the nation to recognize the military science curricula with the award of a leadership studies minor. Contact the Center for Leader Development, (540) 231-7136, for information on how to apply for the minor in leadership studies.

## Undergraduate Course Descriptions (MS)

1005,1006: MS I, AROTC

First year of military science. 1005: Introduction to ROTC. Roles and mission of the Army, including the Army National Guard and Army Reserve. Army customs and traditions. Introduction to drill ceremony, basic first aid, physical training and land navigation. Required participation: leadership lab, physical training and field training exercises. 1006: Basic military skills training. Introduction to marksmanship, small unit tactics and leadership. Required participation: leadership lab, physical training and weekend field training exercises. I (1H,2L,2C)

2005,2006: MS II, AROTC

Second year of military science. 2005: Apply ethics-based leadership skills. Oral presentations, writing concisely, basic military tactics, advanced first aid and land navigation. Required participation; leadership lab, physical training, weekend field exercises. 2006: Team and small unit operations to include radio communications, safety assessments, movement techniques. Required participation: leadership lab and weekend field training exercises. I Pre: 1005, 1006. (1H,2L,2C)

2974: INDEPENDENT STUDY

Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

3005,3006: MS III, AROTC

Third year of military science. 3005: Analysis of the leadership role in directing and coordinating offensive and defensive tactical operations. Introduction to military training management. Practical exercises in land navigation and small unit tactics. 3006: Classroom and practical exercises to prepare cadets for LDAC: emphasis on weapons qualification, physical fitness, leadership techniques, and small unit operations. Practical exercises to enhance oral and written skills. I Pre: 1005, 1006, 2005, 2006. (3H,2L,3C)

4005,4006: MS IV, AROTC

Fourth year of military science. 4005: The role of the military profession in today's society. Ethical dimensions of military decision-making. Introduction to methods of instruction, the conduct of briefings, how to structure and conduct meetings, performance and disciplinary counseling. 4006: Introduction to logistics, personnel management, the Army finance and accounting system, the role of the lieutenant in unit administration and military justice. The military aspect of world geography. Current events and their relevance to the military profession. I Pre: 3005, 3006. (3H,2L,3C)

4964: FIELD STUDY

Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Materials Science and Engineering

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### Overview

### Program Educational Objectives and Student Outcomes

### Curriculum

### Educational Enhancement Opportunities

### Undergraduate Course Descriptions (MSE)

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**Head:** D.E. Clark

**Jack E. Cowling Professor:** D.D. Viehland

**Professors:** D.E. Clark, D. Farkas, R.W. Hendricks, G-Q. Lu<sup>1</sup>, and W.T. Reynolds Jr.

**Associate Professors:** A.O. Aning, L.V. Asryan, S.G. Corcoran, A.P. Druschitz, E.J. Foster, L.J. Guido<sup>1</sup>, P.K. Lu, M. Murayama, G.R. Pickrell, and A.R. Whittington<sup>2</sup>

**Assistant Professors:** C. Hin<sup>3</sup>

**Associate Professor of Practice:** S. McGinnis and T.W. Staley

**Research Associate Professors:** J-F. Li and C.T.A. Suchicital

**Instructors:** C.B. Burgoyne<sup>4</sup>

**Professors Emeritus:** J.J. Brown Jr., R.O. Claus, N.E. Dowling, G.V. Gibbs, D.P.H. Hasselman, and C.W. Spencer

**Adjunct Faculty:** J.T. Abiade, T.W. Chan, O. Delaire, J.L. Hunter, M.M. Julian, S.L. Kampe, M.J. Kelley, K.V. Logan, N. Manjooran, and T.K. Ooi

**Affiliated Faculty**<sup>5</sup>: R.C. Batra<sup>a</sup>, M.J. Bortner<sup>j</sup>, S.W. Case<sup>a</sup>, R.V. Davalos<sup>e</sup>, C. Frazier<sup>h</sup>, A. Goldstein<sup>j</sup>, J.R. Heflin<sup>b</sup>, H. Marand<sup>c</sup>, R. Mirzaeifar<sup>g</sup>, R.B. Moore<sup>c</sup>, K. Ngo<sup>i</sup>, C.B. Williams<sup>g</sup>, and R.H. Yoon<sup>d</sup>

<sup>1</sup> Joint appointment with Electrical and Computer Engineering

<sup>2</sup> Joint appointment with Chemical Engineering

<sup>3</sup> Joint appointment with Mechanical Engineering

<sup>4</sup> Joint appointment with Biomedical Engineering and Mechanics

<sup>5</sup> Faculty with regular appointments in other departments: (a) Biomedical Engineering and Mechanics; (b) Physics; (c) Chemistry; (d) Mining and Minerals Engineering; (e) Institute for Critical Technology and Applied Science; (f) Nanoscale Characterization and Fabrication Laboratory; (g) Mechanical Engineering; (h) Sustainable Biomaterials; (i) Electrical and Computer Engineering; (j) Chemical Engineering

## Overview

Materials engineers and scientists study the structure and properties of engineering materials on scales ranging from the atomic through the microscopic to the macroscopic. These materials include ceramics, metals, polymers, composites, biomaterials, nanomaterials, semiconductors, and electronic, magnetic, and photonic materials. Materials engineers develop new materials, improve traditional materials, and manufacture materials economically through synthesis, processing, and fabrication. They seek to understand physical and chemical phenomena in material structures and to measure and characterize materials properties of all kinds including mechanical, electrical, optical, magnetic, thermal, and chemical. They predict and evaluate the performance of materials as structural or functional elements in engineering systems and structures. They assist engineers in other disciplines and architects in selecting optimal materials for various applications.

Significant opportunities exist for graduates in the aerospace, automobile, transportation, medical, microelectronics, telecommunications, chemical, petroleum, energy storage, power generation, and energy conservation industries, as well as within the basic industries producing materials--for example, the copper, aluminum, steel, ceramics, glass, and polymer industries. Opportunities also exist in government-operated engineering centers and research laboratories. Graduates work in entry level engineering, manufacturing, materials selection and design, quality assurance and control, research and development, technical consulting, management, and sales and marketing. Graduates have an excellent background for post-graduate studies in science, engineering, medicine, law, and business.

## Program Educational Objectives and Student Outcomes

### Educational Objectives

The goal of the BS degree program in MSE is to provide the educational foundation that enables alumni to pursue their personal career objectives. Historically, the majority of our alumni become valued members of industrial and/or research teams within the field of materials science or related technical disciplines while a smaller percentage pursue graduate education or other personal career objectives.

The specific objectives for the BS degree program in MSE are to produce alumni who are:

- effective communicators with written, oral, and visual media:
- able to apply critical thinking skills to engineering and research problems: and
- effective learners able to apply new technical tools, techniques, and knowledge specific to their field of employment or graduate studies.

### Student Outcomes

Upon graduation, students completing the B.S. degree program in MSE will be able to:

#### General Outcomes

- (A) apply knowledge of mathematics, science, and engineering
- (B) design and conduct experiments, as well as analyze and interpret data
- (C) design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, societal, global, political, ethical, health and safety, manufacturability, and sustainability
- (D) function on multidisciplinary teams while maintaining independent thought and expression
- (E) identify, formulate, and solve engineering problems

- (F) understand professional and ethical responsibility
- (G) communicate effectively
- (H) understand the impact of engineering solutions in a global economic, environmental, and societal context
- (I) recognize the need for, and to engage in, lifelong learning
- (J) apply knowledge of contemporary issues
- (K) use the techniques, skills, and modern engineering tools necessary for engineering practice

#### Materials Specific Outcomes

- (L) apply advanced science (such as chemistry and physics) and engineering principles to materials systems/problems
- (M) understand the scientific and engineering principles underlying the four major elements of the field: structure, properties, processing, and performance
- (N) apply and integrate knowledge from each of the above four elements of the field to solve materials selection and design problems
- (O) utilize experimental, statistical, and computational methods consistent with the program educational objectives.

## Curriculum

Students typically enter the MSE Department following completion of their first year studies within the College of Engineering, as administered by the Department of Engineering Education (EngE); a description of required first year coursework can be found within the EngE section of this catalog.

In addition to foundation courses in MSE, students tailor an individualized program of elective study. Fifteen credits of technical electives will be selected to emphasize certain subdisciplines of MSE (e.g., metals, ceramics, polymers, electronic materials, composites, biomaterials, nanomaterials, etc.) or to prepare for a career in certain application areas (e.g., manufacturing, aerospace, automotive, information technology, microelectronics, etc.). Course-work totals 131 credit hours as detailed on the BS in MSE checksheet which can be found at <http://www.registrar.vt.edu/graduation/checksheets/index.html>. Students expecting to graduate beyond the displayed checksheet years should use the last projected term until the checksheet for that calendar year becomes available.

The undergraduate curriculum contains a nationally recognized integrated program of instruction in engineering communication including writing, public speaking, proposal preparation, reporting, research skills, critical and creative thinking, and graphical presentation. More information regarding this unique program can be found at <http://www.mse.vt.edu/ecp>.

The undergraduate program culminates with a two-semester team-oriented engineering design project in which the students address a significant problem in their area of special interest. MSE is unique within the College of Engineering in that they offer a more ambitious project for students enrolled in the University Honors program.

The MSE students have pursued various minors including Microelectronics, Green Engineering, Chemistry, Mathematics, Music, a foreign language, and various others.

The B.S. in MSE degree program at Virginia Tech is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.

## Educational Enhancement Opportunities

Students of MSE can optionally participate in the cooperative education program in which qualified students may alternate semesters of study with semesters of professional employment. ([www.career.vt.edu/coop/coop1.html](http://www.career.vt.edu/coop/coop1.html))

Honors-eligible students may participate in a formalized program of study leading to one of several university honors degrees (see [www.honorscollege.vt.edu](http://www.honorscollege.vt.edu)). MSE traditionally graduates several

students with the degree "Bachelor of Science in Materials Science and Engineering (in Honors)", as well as some of the other Honors designations. Inquiries to MSE Advising are welcomed.

There are several department guided programs for study abroad and cultural exchanges. The MSE department has established relationships with several universities offering strong MSE programs in other countries. Programs in which the student studies abroad for one or two semesters typically have a foreign language requirement. At this time, programs are available in China, France, Germany and Switzerland. Students with interest in said programs are strongly advised to have at least two years of high school experience with the appropriate language. Short-term (3 week) summer programs are available, which do not have a language requirement. Inquiries to MSE Advising are welcomed.

## Undergraduate Course Descriptions (MSE)

### 1004: MATERIALS IN TODAY'S WORLD

An introductory course designed for the student with a basic high school science background who wishes to understand and learn about the exciting materials developments which are affecting us all in today's world. The course will introduce the structures and properties of metals, ceramics, polymers (plastics), composites, and materials for electronic and optical applications. Students will also gain an appreciation for the processing and design limitations of materials used in everyday applications. (1H,1C)

### 2014: MATERIALS ENGINEERING TRANSITION

Supplemental coverage of introductory topics not included in courses delivered to non-MSE majors. Pre: 2034 or 3094 or AOE 3094. (1H,1C)

### 2034: ELEMENTS OF MATERIALS ENGINEERING

This course is designed to introduce the non-MSE student to the structures and properties of metals, ceramics, polymers, and composites. In addition, students will gain an understanding of the processing and design limitations of these materials, as well as being introduced to new classes of materials being developed to meet the ever expanding range of material requirements. Non-MSE majors only. Pre: CHEM 1035. Co: PHYS 2305. (3H,3C)

### 2044: FUNDAMENTALS OF MATERIALS ENGINEERING

This course is designed to introduce the MSE major to the structures and properties of metals, ceramics, polymers, composites, and electronic materials. Students will also gain an understanding of the processing and design limitations of materials. Topics fundamental to the further study of materials, such as crystal structures, phase diagrams, and materials design and processing will be emphasized as foundations for future MSE courses. Pre: CHEM 1035. Co: PHYS 2305. (4H,4C)

### 2054: FUNDAMENTALS OF MATERIALS SCIENCE

Introduces MSE majors to fundamental underlying concepts governing phase equilibrium, microstructure, electronic properties of materials, and transport phenomena as a foundation to understanding materials behavior and processing. Pre: 2044. (3H,3C)

### 2114: MATH PROGRAMMING MSE I

Basic computational and graphical functions in mathematics oriented programming languages using data and engineering examples from the field of Materials Science. Students apply general methods to problems of their choice through mini- projects. Pre: 2044. (1H,1C)

### 2884: MATERIALS ENGINEERING PROFESSIONAL DEVELOPMENT I

Library engineering research skills, technical computer graphics, basic engineering workplace communication skills, basic engineering teamwork skills, introduction to engineering ethics, resumes and letters of introduction, gender issues in the workplace, professional poster presentations, and engineering public speaking. Pre: MSE major, sophomore status. (3L,1C)

### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 2994H: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3044: TRANSPORT PHENOMENA IN MSE

Mass transport (continuum and atomistic diffusion), heat transport and fluid flow (momentum transport). Analytical and computer based methods for solving transport problems. Pre: 2044, MATH 2214. (3H,3C)

#### 3054 (ESM 3054): MECHANICAL BEHAVIOR OF MATERIALS

Mechanical properties and behavior of engineering materials subjected to static, dynamic, creep, and fatigue loads under environments and stress states typical of service conditions; biaxial theories of failure; behavior of cracked bodies; microstructure-property relationships and design methodologies for homogeneous and composite materials. Pre: ESM 2204, (MSE 2034 or MSE 2044 or MSE 3094 or AOE 3094 or CEE 3684). (3H,3C)

#### 3064 (ESM 3064): MECHANICAL BEHAVIOR OF MATERIALS LABORATORY

Laboratory experiments on behavior and mechanical properties of solid materials. Tension, compression, bending, hardness, nano-indentation, and impact tests; behavior of cracked bodies; fatigue and crack growth tests; creep deformation; microstructure-property relationships; laboratory equipment, instrumentation, and computers. Co: 3054. (3L,1C)

#### 3094 (AOE 3094): MATERIALS & MANUFACTURING FOR AERO & OCEAN ENGINEERS

This course introduces the student of Aerospace and/or Ocean Engineering to the fundamental properties of materials typically required for structural design. The performance characteristics of metals, ceramics, polymers, and composites are presented and contrasted. Foundation principles underlying materials manufacturing are also presented with the goal of providing an understanding of how processing affects material properties and performance. Must have a C- or better in pre-requisite CHEM 1035. Non-MSE majors only. Pre: CHEM 1035. Co: ESM 2204, PHYS 2305. (3H,3C)

#### 3104 (GEOS 3504): MINERALOGY

Principles of modern mineralogy, crystal chemistry, and crystallography, with emphasis on mineral atomic structure and physical property relationships, mineralogy in the context of geology, geochemistry, environmental science and geophysics, phase equilibria, mineral associations, and mineral identification, and industrial applications of minerals. There are three required field trips during the semester. Pre: (MATH 1016 or MATH 1025), CHEM 1036. (2H,3L,3C)

#### 3114: MATHEMATICS PROGRAMMING IN MATERIALS SCIENCE II

Advanced computational and graphical methods in mathematics oriented programming languages. Students develop programs that solve and/or provide visualizations of solutions to materials science and engineering problems. Pre: 2114. (1H,1C)

#### 3134: CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES

Provides a comprehensive foundation in crystallography including lattices, point groups, space groups, reciprocal lattices, properties of x-rays, and electron density maps, all leading to a formal description of structures and an interpretation of the published crystallographic data. Pre: 2044. (3H,3C)

#### 3204: FUNDAMENTALS OF ELECTRONIC MATERIALS

Introduction to the electrical, magnetic, and optical properties of solid-state materials. Development of atomic scale models for physical phenomena that are observable at the macroscopic scale. Connection is made between basic materials properties and the operational characteristics of selected solid-state devices. Pre: 2054, PHYS 2306. (3H,3C)



### 3304: PHYSICAL METALLURGY

Deformation of crystalline solids and its relationship to crystal structure and crystal defects: crystal structures of metals, dislocations and plastic deformation, vacancies, recovery, recrystallization, grain growth, deformation twinning and martensite. Pre: 2044. (3H,3C)

### 3314: MATERIALS LABORATORY I

Sample preparation for materials characterization techniques including various types of microscopy, spectroscopy, diffraction, and hardness testing. Instruction in the use of heat treating equipment and polishing and chemical etching procedures. Pre: 2044. (3L,1C)

### 3324: ELEMENTARY METAL CASTING LABORATORY

Introduction to metal casting processes; gating, risering, molding and purging. Hands-on experience. Emphasis on safe foundry practices. Oral and written reports are required. Pre: (2034 or 2044), ISE 2214. Co: 3354. (3L,1C)

### 3334: TEST METHODS FOR FOUNDRY LABORATORIES

The properties of foundry sand, molten metal and castings are measured using standard laboratory test procedures. Safe foundry practices are emphasized. Oral and written reports are required. Pre: (2034 or 2044), ISE 2214. Co: 3354. (1H,2L,2C)

### 3344: GOVERNMENT REGULATION OF THE METAL CASTING INDUSTRY

Introduction to the role of federal, state, and local regulation of the metal casting industry. Implementation of OSHA, EPA, and DEQ regulations in an inherently dangerous industry. Emphasis is placed on the implementation of these regulations in a University environment as implemented in the VT-FIRE facility. Visits to VT-FIRE and other local production foundries are included. Oral and written reports required. Pre: (2034 or 2044), ISE 2214. (3H,3C)

### 3354: FOUNDRY SAFETY

Provides comprehensive training in foundry safety procedures and policies. (May register multiple times). Co: 3324 or 3334 or 4324. Pass/Fail only. Pre: (2034 or 2044), ISE 2214. (2H,1C)

### 3884: MATERIALS ENGINEERING PROFESSIONAL DEVELOPMENT II

Public speaking and workplace communications for materials engineers, business writing for the engineering workplace, teamwork skills, engineering ethics, collaborative writing, engineering management skills, and gender issues in the workplace. Extends the basic treatment of these topics given in MSE 2884. Pre: MSE major, junior status. Pre: 2884. (3L,1C)

### 3954: STUDY ABROAD

Variable credit course.

### 4034: THERMODYNAMICS OF MATERIALS SYSTEMS

Topics in thermodynamics on the solution of materials selection and design related problems such as materials stability at high temperatures and in corrosive chemical environments. Thermodynamic principles important in controlling equilibrium in single component systems and multicomponent solid solutions and in establishing the thermodynamic driving force in kinetic processes which are important in materials processing unit operations. Estimation of thermodynamic properties and equilibrium calculations in multicomponent and multiphase systems. Pre: 2044. Co: CHEM 1036. (3H,3C)

### 4044: POWDER PROCESSING

Processing methods associated with powder synthesis, characterization, colloidal processing, and forming of powder compacts. Theory of solid state and liquid phase sintering. Pre: 3044. (3H,3C)

### 4055-4056: MATERIALS SELECTION AND DESIGN I AND II

4055: Selection of materials for engineering systems, based on constitutive analyses of functional requirements and material properties. 4056: The role and implications of processing on material selection. Pre: 3044, 3054, (3204, 3304) or (3204, 4414) or (3204, 4554) or (3304, 4414) or (3304, 4554) or (4414, 4554) for 4055; 4055 for 4056. (3H,3C)

#### 4075-4076: SENIOR DESIGN LABORATORY

A capstone design course centered around an open-ended, faculty-advised senior project involving the design of a process, material, or a technique for solving a technological problem. Senior standing in MSE required. Pre: 4644 for 4075; 4075 for 4076. Co: 4085, 4055 for 4075; 4086 for 4076. 4075: (3L,1C) 4076: (6L,2C)

#### 4085-4086: SENIOR DESIGN RECITATION

Capstone course run in parallel with faculty-advised Senior Project Laboratory (MSE 4075-4076). Topics in engineering professional practice, project planning, and reporting. Preparation of proposals, interim reports, final project reports, and discussion of the environmental, social, and economic impacts of engineering. Instruction in design theory, ethics, continuous learning, and global issues. Senior Standing in MSE. Co: 4075 or 4095H for 4085. 4076 or 4096H for 4086. Pre: 3884 for 4085; 4085 for 4086. 4085: (2H,2C) 4086: (1H,1C)

#### 4095H-4096H: HONORS SENIOR DESIGN-LABORATORY

Two-semester MSE capstone design course centered around an open-ended, faculty-advised senior honors project involving the design of a process, material, or a technique for solving a technological problem. Outcomes and work effort are consistent with that expected of honors students. MSE 4095H: Literature search, planning and proof-of-concept studies of assigned project. Individual preparation and presentation of an original senior honors thesis related to a team project in which the students also participate. Presentation of detailed project plan to faculty. MSE 4096H: Execution of proposed project, analysis of results and preparation of journal-quality presentation of results. Oral presentation of results to MSE faculty and students. Enrollment in University Honors and senior standing in MSE required. Pre: 4644 for 4095H; UH 4095H, MSE 4095 for 4096H. Co: 4085, 4055 for 4095H; 4086, 4086 for 4096H. (9L,3C)

#### 4164: PRINCIPLES OF MATERIALS CORROSION

Introduction to the scientific 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. Co: 4034. (3H,3C)

#### 4234 (ECE 4234): SEMICONDUCTOR PROCESSING

Manufacturing practices used in silicon integrated circuit fabrication and the underlying scientific basis for these process technologies. Physical models are developed to explain basic fabrication steps, such as substrate growth, thermal oxidation, dopant diffusion, ion implantation, thin film deposition, etching, and lithography. The overall CMOS integrated circuit process flow is described within the context of these physical models. Pre: ECE 2204 or ECE 3054. (3H,3C)

#### 4304: METALS AND ALLOYS

This course covers the production, properties and uses of commercially important metals and alloys. The influence of structure, chemistry, and processing upon the properties of metals is emphasized. Alloy selection is discussed. Mechanical, electrical, thermal and chemical characteristics of ferrous and nonferrous alloys are studied. Pre: 2034 or 2044. (3H,3C)

#### 4305,4306: PHYSICAL METALLURGY AND MODELING OF METAL CASTING

4305: Casting processes; solidification and its influences on the structure and chemistry of castings; role of fluid flow and heat transfer in mold design; origin and control of casting defects. 4306: Design, layout, and modeling of metal components cast from aluminum, bronze, iron and steel; design of metal running systems; modeling of solidification process. Co: 3044 or ME 3304 for 4306. Pre: 3304 for 4305; (2034 or 2044), 3324 for 4306. (3H,3C)

#### 4324: ADVANCED METAL CASTING LABORATORY

Advanced metal casting processes; no-bake sand molds; investment casting; rapid prototyping; melting and casting of aluminum, bronze, iron and steel. Casting finishing including shot and sand blasting. Hands-on experience. Emphasis on safe foundry practices. Oral and written reports are required. Pre:

3324. Co: 3354. (1H,3L,2C)

#### 4334: APPLIED MATERIALS ANALYSIS

Fundamental materials theory applied to structure-property relationships in materials science and engineering through basic characterization techniques. Demonstrations, lab exercises, and practical application of modern characterization techniques such as Scanning and Transmission Electron Microscopy (SEM, TEM), Focused Ion Beam (FIB), and Atomic Force Microscopy (AFM). Pre: 2044, (3314 or 4424). (2H,3L,3C)

#### 4384: NUCLEAR MATERIALS

An introduction to materials for nuclear applications with emphasis on fission reactors. Fundamental radiation effects on materials; material properties relevant to structural, moderator, reflector, blanket, coolant, control shielding and safety systems; processes such as nuclear fuel cycles, fuel enrichment and reprocessing; and related structural systems. Pre: (3044 or ME 3304), (MSE 3054 or ESM 3054 or ME 3614). (3H,3C)

#### 4414: PHYSICAL CERAMICS

Study of the relationships between the physical properties (thermal, optical, mechanical, electrical and magnetic) and the structure and composition of ceramics at the atomic and microscopic level as affected by processing and service environment. Emphasis will be placed on application and design using structural ceramics. Pre: 2044. (3H,3C)

#### 4424: MATERIALS LABORATORY II

Processing and characterization of materials; exploration of the influence of processing parameters on physical and mechanical properties. Emphasis on material synthesis. Pre: 2044. (3L,1C)

#### 4544 (CHEM 4074): LABORATORY IN POLYMER SCIENCE

Experimental techniques used in the synthesis of various linear polymers, copolymers, and crosslinked networks. Determination of polymer molecular weights and molecular weight distribution. Methods used in the thermal, mechanical, and morphological characterization of polymeric systems. Pre: CHEM 3616, CHEM 4534. (1H,3L,2C)

#### 4554: POLYMER ENGINEERING

This course is designed to introduce the student to polymers from the MSE perspective. The basics of polymer syntheses and polymerization will be outlined. The relationship between processing, structure, and properties will be presented with respect to the performance and design requirements of typical polymer applications. Pre: 2044. (3H,3C)

#### 4574: BIOMATERIALS

Materials for biomedical applications. Basic material types and properties, functional uses of materials in medical applications, and tissue response mechanisms. Integrated design issues of multicomponent material design in prosthetic devices for hard and soft tissues, orthopedics, cardiovascular, and drug delivery applications. Pre: 3054 or ESM 3054. (3H,3C)

#### 4584: BIOMIMETIC MATERIALS

Introduction to structure property relationships in biological materials such as wood, bone, shells, spider silk, connective tissue, blood vessels and jellyfish. Proteins and polysaccharides, biosynthesis and assembly, biomineralization, hierarchical organization. Introduction to tissue engineering and regenerative medicine. Life cycle, environmental aspects of biofabrication. Pre: (2034 or 2044), (CHEM 1036 or BIOL 1106). (3H,3C)

#### 4604: 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. Pre: (2034 or 2044), ESM 2204. (3H,3C)

#### 4614: NANOMATERIALS

Synthesis methods of 0D nanoparticles, 1D nanotubes/nanowires/nanorods, 2D nanoribbons and

nanofilms, and special nano-features on supports. Bottom-up and top-down approaches. Methods of characterization for nanomaterials. Processing of nanospecies into higher order dimensions; conventional processing techniques; techniques developed solely for nanomaterials. Chemical, physical, mechanical, and electrical properties of nanomaterials and applications of nanomaterials. Pre: 4034. (3H,3C)

**4644: MATERIALS OPTIMIZATION THROUGH DESIGNED EXPERIMENTS**

Methods of analysis of variation in materials systems, manufacturing or R&D through the use of statistical methods including experimental design techniques. Instructional examples related to Materials Science and Engineering. Pre: (3314 or 4424). (3H,3C)

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

### Music

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[Overview](#)

[Satisfactory Progress](#)

[Undergraduate Course Descriptions \(MUS\)](#)

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**Chair:** Tracy Cowden

**Professors:** K. A. Holliday, J. R. Sochinski, and W. J. Crone

**Associate Professors:** I.I. Bukvic, R. C. Cole, T. Cowden, W. E. Easter, W. J. Glazebrook, E. Lyon, and A. Weinstein

**Assistant Professors:** D. Bigler, J. Crafton, P. Middleton, C. Nichols, P. Paglialonga, A. Stevens, B. Thorsett, A. Wyatt, J. Caldwell, A. Gillick, and H. Yoo

**Instructors:** E. Crone, M. E. Dunston, R.J. Masters, D. M. McKee, J. Bean, N. Paglialonga, and W. Parrish

**Professor Emeritus:** D. Widder, J. Husser, V. Burnsed, and D. Jacobson

**Academic Advisor:** Tammy Henderson

Web: [www.performingarts.vt.edu](http://www.performingarts.vt.edu)

### Overview

The Virginia Tech Department of Music provides high-quality training to a select number of music majors, as well as ensembles and courses for large numbers of non-music majors. Instruction takes place in a handsome new facility which has superb rehearsal rooms, well-designed practice rooms and music teaching studios, a beautiful acoustically engineered Recital Salon, and laboratories with state-of-the-art electronic equipment for music study, recording, and digital music.

The curriculum offers an excellent liberal arts education with a low professor/student ratio combined with the library, computer facilities, and cultural interaction which only a major comprehensive university can provide. Learning is enhanced by the use of music technology across the curriculum and innovative

programs such as laboratory ensembles and extensive teaching experiences in the music education program. Together with traditional degree programs in Performance, Music Education, Technology and Composition, students may design a degree plan combining music with virtually all other majors offered by the university.

Virginia Tech faculty artists and scholars have performed and lectured at conventions, in music festivals, and on concert series throughout the United States and in Canada, Europe, Asia, and South America. Each year, internationally known guest artists join forces with our faculty to perform world caliber performances on campus.

Prospective music majors must successfully complete an audition/interview. Contact the chairperson of the Music Scholarship and Audition Committee, School of Performing Arts, 195 Alumni Mall (0141), Henderson Hall, Room 247, Blacksburg, Virginia 24061-0240 to receive information concerning auditions and scholarship opportunities. Scholarship support is available. Please also refer to the School of Performing Arts general information section for details.

The major in music, leading to a B.A., emphasizes four areas of music: music education; performance; technology and composition as well as a designed option. This designed option area is provided as a means for a student to tailor music and non-music courses into a curriculum that best meets the interests of the student. In addition to fulfilling the Curriculum for Liberal Education and the core curriculum requirements of the College of Liberal Arts and Human Sciences, the music major must pursue a concentration in one of the above areas of emphasis.

There are eight primary options available to music majors. These are:

- 84-Credit Music Education Option (see website for details)
- 51-Credit Performance - Liberal Arts Option
- 78-Credit Performance - Professional Vocal Option
- 78-Credit Performance - Professional Instrumental Option
- 78-Credit Composition - Professional Option
- 52-Credit Music Technology - Liberal Arts Option
- 78-Credit Music Technology - Professional Option
- 77-Credit Designed Option - Professional

In addition, all music majors must meet a minimum level of piano proficiency no later than two semesters prior to graduation. Music majors are expected to participate in an ensemble or as an accompanist every semester of residence and attend a minimum number of concerts and recitals. Additional curriculum and policy information is available in the *Handbook for Music Majors* on the department website.

There are three options available as a minor in music, including a general option, a music technology option and a jazz option. The minor in music consists of 18 semester hours selected from performance, history/literature, and theory/composition. Interested students should contact Tammy Henderson, Virginia Tech, 246 Henderson Hall, Blacksburg, Virginia 24061-0240 or at tammyh@vt.edu for the exact requirements.

The department follows the Curriculum for Liberal Education except in Area 4 - Scientific Reasoning and Discovery, of which two credits of laboratory science are not required. Both the Department of Music and the university foreign language requirement are the same, except for vocal performance majors.

## **Degree Requirements**

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will

not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in music.

Satisfactory progress requirements toward the B.A. in Music can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (MUS)

### 1004 (TA 1004): SCHOOL OF PERFORMING ARTS FIRST YEAR EXPERIENCE

Orientation to the School of Performing Arts philosophy and the resources of the School, the College, and the University. Cultivate a common intellectual, analytical, and creative conversation among first-year students. Enhance student participation in the creative and scholarly life of the School's programs. Foster a sense of community and understanding across disciplines. (1H,1C)

### 1005-1006: THEORY/FUNDAMENTALS

Development of understanding the basic components of the composition of music through reading and writing the symbolic notation as it appears on the page, and realizing the experimental and expressive content of music performance through singing, ear training, and practice at a keyboard instrument. (3H,3C)

### 1104: MUSIC APPRECIATION

Introduction to fundamental aspects of Western Art Music of major periods to give the student a basic understanding of the breadth and nature of this art form. (3H,3C)

### 2025-2026: THEORY/HARMONY

Study of structure, relationship, and function of chords through harmonization of bass and melody lines and through written analysis. Majors and minors only. Pre: 1006. Co: 2045, 2035 for 2025; 2046, 2036 for 2026. (3H,3C)

### 2045-2046: SIGHTSINGING LABORATORY

Study and practice of techniques involved in the sight reading and sightsinging of printed music. Majors and minors only. Co: 2035, 2025 for 2045; 2036, 2026 for 2046. (3L,1C)

### 2054: INTRODUCTION TO MUSIC TECHNOLOGY

History, theory, and applications of music technology for notating music and recording and editing audio, using computer software and digital audio equipment. Consent Required. (3H,3C)

### 2055-2056: AUDIO TECHNOLOGY FOR MUSIC

Develops basic understanding of audio technology for musical applications, focusing on today's digital audio recording and editing technologies including microphone use, live recording, and studio session recording. Develops critical listening skills through lab experimentation and recording. Pre: 2054 and permission of instructor required. Pre: 2054. (3H,3C)

### 2065-2066: MUSIC COMPOSITION

Organizing the basic elements of music: pitch, rhythm, timbre, articulation, and dynamics. Composing pieces for solo instruments and duos. Preparing scores and parts, for performances and recordings of the compositions. Knowledge of basic music theory required. Consent Required. (2H,2C)

**2115,2116: SURVEY OF MUSIC**

Music and composers of all historical periods will be heard and studied to acquaint the students with the music of Western Civilization. The emphasis will be on listening rather than on reading, writing, and performing music skills. (3H,3C)

**2214: CLASS APPLIED PIANO**

Group piano lessons for beginners or for students at an early stage of keyboard development. May be repeated for 1 credit. Consent required. (3L,1C)

**2224: CLASS APPLIED VOICE**

Group voice lessons for beginners or for students at an early stage of vocal development. May be repeated for 1 credit. Consent required. (3L,1C)

**2234: CLASS APPLIED STRINGS**

Group string lessons for beginners or for students at an early stage of string development. May be repeated for 1 credit. Consent required. (3L,1C)

**2244: CLASS APPLIED WOODWINDS**

Group woodwind lessons for beginners or for students at an early stage of woodwind development. May be repeated for 1 credit. Consent required. (3L,1C)

**2254: CLASS APPLIED BRASS**

Group brass lessons for beginners or for students at an early stage of brass development. May be repeated for 1 credit. Consent required. (3L,1C)

**2264: CLASS APPLIED PERCUSSION**

Group percussion lessons for beginners or for students at an early stage of development. May be repeated for 1 credit. Consent required. (3L,1C)

**2274: MUSIC EDUCATION LAB ENSEMBLE**

Music education laboratory ensemble. Performance techniques, teaching methods, management procedures, materials and literature for school music ensembles. May be repeated for credit. (1L,1C)

**2284: PIANO ACCOMPANYING**

Examine and practice the skills necessary for successful piano accompanying. Develop keyboard skills such as sightreading, transposition, choral score reading, and harmonization. Learn principles of accompanying vocal repertoire, instrumental repertoire, including large ensemble repertoire; adapt orchestral reductions for piano. Instructor consent required. (2H,2C)

**2514: INDIVIDUAL APPLIED VOICE**

Individual instruction in voice. May be repeated. Consent and audition required. Variable credit course.

**2515-2516: VOCAL DICTION**

An introduction to principles of vocal diction for singing using the International Phonetic Alphabet and standard foreign-language pronunciation techniques. Two semesters. Fall semester: Italian, Latin, and English. Spring semester: French and German. One credit hour. Pre: 2514 or 4514. (1L,1C)

**2524: INDIVIDUAL APPLIED KEYBOARD**

Individual instruction in keyboard. May be repeated. Consent and audition required. Variable credit course.

**2534: INDIVIDUAL APPLIED VIOLIN**

Individual instruction in violin. May be repeated. Consent and audition required. Variable credit course.

**2544: INDIVIDUAL APPLIED VIOLA**

Individual instruction in viola. May be repeated. Consent and audition required. Variable credit course.

**2554: INDIVIDUAL APPLIED CELLO**

Individual instruction in cello. May be repeated. Consent and audition required. Variable credit course.



**2564: INDIVIDUAL APPLIED BASS**

Individual instruction in bass. May be repeated. Consent and audition required. Variable credit course.

**2574: INDIVIDUAL APPLIED FLUTE**

Individual instruction in flute. May be repeated. Consent and audition required. Variable credit course.

**2584: INDIVIDUAL APPLIED OBOE**

Individual instruction in oboe. May be repeated. Consent and audition required. Variable credit course.

**2594: INDIVIDUAL APPLIED CLARINET**

Individual instruction in clarinet. May be repeated. Consent and audition required. Variable credit course.

**2604 (TA 2604): INTRODUCTION TO ARTS MARKETING**

An introduction to the theories and practice of marketing and building community engagement as applied to arts activities and professional not-for-profit arts organizations, through a survey of standard marketing approaches, examination of current practices in the field and direct hands-on experience. (3H,3C)

**2614: INDIVIDUAL APPLIED SAXOPHONE**

Individual instruction in saxophone. May be repeated. Consent and audition required. Variable credit course.

**2624: INDIVIDUAL APPLIED BASSOON**

Individual instruction in bassoon. May be repeated. Consent and audition required. Variable credit course.

**2634: INDIVIDUAL APPLIED HORN**

Individual instruction in horn. May be repeated. Consent and audition required. Variable credit course.

**2644: INDIVIDUAL APPLIED TRUMPET**

Individual instruction in trumpet. May be repeated. Consent and audition required. Variable credit course.

**2654: INDIVIDUAL APPLIED TROMBONE**

Individual instruction in trombone. May be repeated. Consent and audition required. Variable credit course.

**2664: INDIVIDUAL APPLIED BARITONE**

Individual instruction in baritone. May be repeated. Consent and audition required. Variable credit course.

**2674: INDIVIDUAL APPLIED TUBA**

Individual instruction in tuba. May be repeated. Consent and audition required. Variable credit course.

**2684: INDIVIDUAL APPLIED PERCUSSION**

Individual instruction in percussion. May be repeated. Consent and audition required. Variable credit course.

**2714: INDIVIDUAL APPLIED HISTORICAL WIND INSTRUMENTS**

Individual instruction in historical wind instruments. May be repeated. Consent and audition required. Variable credit course.

**2724: INDIVIDUAL APPLIED HISTORICAL STRING INSTRUMENTS**

Individual instruction in historical string instruments. May be repeated. Consent and audition required. Variable credit course.

**2734: INDIVIDUAL APPLIED COMPOSITION**

Individual instruction in composition. May be repeated. Consent and audition required. Variable credit course.

**2754: INDIVIDUAL APPLIED RECORDING**

Individual instruction through directed experiential learning of music recording and production. Integration of critical listening, acoustics, audio recording, and signal processing with music theory and performance.

An emphasis on hands-on exploratory research in the use of instruments, acoustics, and microphone techniques combined with traditional methods and emerging technologies to capture and produce recordings of musical performances and works in a natural and effective manner. Permission required. May be repeated for a maximum of 8 hours. Variable credit course. Pre: 2055.

#### 2815-2816: JAZZ IMPROVISATION

Fundamental principles of jazz improvisation. Topics include interval relationships, chord identification, modes and modality, blues and ii-V-I chord progressions. Pre: Permission of instructor required. (2H,2C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3024: COUNTERPOINT

Study of the development and aesthetics of contrapuntal techniques throughout the common practice period. Pre: 2026. (3H,3C)

#### 3035-3036: ADVANCED CLASS PIANO

Develop keyboard skills such as sightreading, harmonization, transposition, learn all scales/arpeggios and important keyboard progressions. A grade of C or better required in prerequisite. Pre: 2214 for 3035; 3035 for 3036. (3L,1C)

#### 3044: ORCHESTRATION & ANALYSIS

An introduction to the craft of scoring and arranging of music for full orchestra. Analysis of scores, small projects and a full orchestration project. Pre: 3034. (3H,3C)

#### 3045-3046: ADVANCED EAR TRAINING

3045: Hearing chromatic chord function in melodic and harmonic contexts. Sight-singing chromatic melodies and performing chromatic progressions. Aurally recognizing musical form (binary, ternary, strophic). Discovering markedness in common practice era music and recognizing commonalities with and differences from other music cultures A grade of C or better required in prerequisite. 3046: Hearing chord function in advanced chromatic melodic and harmonic contexts. Sight-singing advanced chromatic melodies and performing highly chromatic progressions. Aurally recognizing musical form (sonata, rondo, other forms). Hypothesizing about evolution of style and articulating intertextual experience. A grade of C or better required in prerequisite. Pre: 2046 for 3045; 3045 for 3046. (3L,1C)

#### 3054: INTRODUCTION TO VOCAL/CHORAL ARRANGING

Techniques of arranging music for vocal/choral ensembles. Emphasis on transcription from recordings to develop rhythmic, melodic, and harmonic dictation skills. Discussion, transcription, listening, small writing exercises, final project. Pre: 3035, 3036. (3H,3C)

#### 3055-3056: MUSIC AND MEDIA PRODUCTION

Develops advanced knowledge of music production through practical application of music recording and production technologies, including advanced microphone techniques, critical listening, and critical artistic evaluation skills. Individual and group production projects. Hands-on experience with a variety of expressive media technologies including CD and DVD production in a collaborative, inter-disciplinary team approach. Pre: 2056 and continuation examination. Pre: 2056. (3H,3C)

#### 3064: DIGITAL SOUND MANIPULATION

Study of recording technology and its effects on music. Aesthetics of electronic music. Recording and editing digital sound. Visual programming for live sound synthesis and processing. Acoustic compilers for programmatic sound processing and synthesis. Individual creative applications of tools learned in class. Team-based work on creative projects. (3H,3C)

### 3065-3066: COMPUTER MUSIC AND MULTIMEDIA DESIGN

A two-semester study of interactive multimedia composition and performance software as a foundation for creative work and research endeavors. Also provides an in-depth study of digital sound synthesis, algorithmic creation of multimedia content, and the design of audio-visual interactive systems using latest technologies. Must meet pre-requisite or have permission of the instructor Pre: 2054 for 3065; 2054, 3065 for 3066. (3H,3C)

### 3114: SYMPHONIC LITERATURE

Study of representative works of symphonic music from the eighteenth, nineteenth, and twentieth centuries, with corollary readings in the history of musical ideas. Consent required. (3H,3C)

### 3115,3116: MUSIC IN AMERICA

An introduction to the history and stylistic evolution of American music from the seventeenth century to the present. (3H,3C)

### 3124: 20TH CENTURY MUSIC LITERATURE

An introduction to music in Europe and America since 1945; supplementary study in the aesthetics of contemporary music. Consent required. (3H,3C)

### 3134: VOCAL MUSIC LITERATURE

Covers vocal music of Europe and America, especially music composed the eighteenth century. Examines differences in style and forms of choral and solo-vocal expression characteristic of the Baroque, Classic, Romantic, and Modern eras. Discusses issues of vocal performance practice. Ability to read music required. (3H,3C)

### 3135-3136: HISTORY AND ANALYSIS OF MUSICAL STYLES

The history of Western music from 1100 to the present as an evolution of musical styles. Extensive analysis of the music, stylistic attributes, normative forms, and representative literature of each period. Historical and philosophical background of each period. The study of analytical techniques to improve comprehension and performance. Pre: 2026 for 3135; 2026, 3135 for 3136. Co: 3145 for 3135; 3146 for 3136. (3H,3C)

### 3144: EARLY MUSIC LITERATURE

Covers vocal and instrumental music from the Middle Ages to the eighteenth century. Examines differences in style and forms of expression characteristic especially of Medieval, Renaissance, and early Baroque music. Discusses issues of performance practice. Ability to read music required. (3H,3C)

### 3145-3146: MUSICAL STYLES LITERACY LABORATORY

Aural study of Western music from 1100 to the present as an evolution of musical styles. Extensive listening to the music of each stylistic period. Supervised as well as self-paced study using HyperMedia technology. Automated examinations. Co: 3136, 3135 for 3145. (1L,1C)

### 3154: PIANO LITERATURE

Study of representative works of keyboard repertoire from the 17th century to the works of contemporary composers. Extensive stylistic analysis and discussion of performance practice. Pre: consent required. (3H,3C)

### 3164: HISTORY OF ELECTRONIC MUSIC

Electronic music literature in historical context. Electronic music practices of the 20th and 21st centuries. The technologies of electronic music. Analysis of electronic music. Historical origins and trends in electronic music. Connections between experimental and popular forms of electronic music. (3H,3C)

### 3214: TEACHING MUSIC IN THE ELEMENTARY SCHOOL

Methods of teaching elementary school music. Emphasis on Kodaly, Orff, and traditional music textbook series approaches to teaching music in elementary schools. Pre: Instructor permission and successful completion of sophomore music continuation exam. Co: 4964. (3H,3C)

### 3225-3226: CONDUCTING

An introduction to the practice and theory of ensemble conducting and leadership. 3225: Basic

conducting skills, and choral conducting. 3226: Intermediate conducting skills, and instrumental conducting. Consent required. (3H,3C)

#### 3234: PIANO PEDAGOGY

Examination of principles and practice of piano pedagogy. Covers teaching methods, materials and literature for the independent studio teacher. Pre: consent required. (3H,3C)

#### 3314: INSTRUMENTAL ENSEMBLE MUSIC

Instruction and participation in the various instrumental musical performance ensembles under direction of members of the music faculty. 3314 and/or 3414 may be repeated for a combined maximum of 8 hours. Consent and audition required. (3H,1C)

#### 3414: CHORAL ENSEMBLE MUSIC

Instruction and participation in the various choral ensembles under the direction of the music faculty. 3314 and/or 3414 may be repeated for a combined maximum of 8 hours. Consent and audition required. (3H,1C)

#### 3815-3816: ADVANCED JAZZ IMPROVISATION

Topics will include in-depth analysis of the great improvisers in multiple genres with a focus on developing professional-level skills. Pre: 2816 for 3815; 3815 for 3816. (2H,2C)

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4014: TOPICS IN ADVANCED ELECTROACOUSTIC RESEARCH

Rotating advanced research topics in electroacoustic music. Sonification, spatialization, algorithmic music, electronic music instrument design, digital performance ensembles, and advanced computer music composition. Repeatable with different content up to a maximum of 12 credit hours. Pre: 3066, 3164. (3H,3C)

#### 4055-4056: MUSIC TECHNOLOGY SENIOR SEMINAR

Weekly seminars in music technology with group discussion of progress in current student projects, the current state of artistic and business practices in the recording industry, and guest lecturers drawn from the professional world. Pre: 3056. (1H,1C)

#### 4124: SPECIAL TOPICS IN MUSIC HISTORY AND LITERATURE

Specific, in depth study of one of several topics in music history and or literature. Pre: 3136. (3H,3C)

#### 4204: REHEARSAL TECHNIQUES AND MATERIALS

Techniques and materials for rehearsing secondary school music performance ensembles. Pre: Instructor permission and successful completion of the sophomore music continuation exam. (3H,3C)

#### 4514: ADVANCED INDIVIDUAL APPLIED VOICE

Individual instruction in voice at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2514.

#### 4524: ADVANCED INDIVIDUAL APPLIED KEYBOARD

Individual instruction in keyboard at an advanced level. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2524.

#### 4534: ADVANCED INDIVIDUAL APPLIED VIOLIN

Individual instruction in violin at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2534.

#### 4544: ADVANCED INDIVIDUAL APPLIED VIOLA

Individual instruction in viola at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2544.

#### 4554: ADVANCED INDIVIDUAL APPLIED CELLO

Individual instruction in cello at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2554.

**4564: ADVANCED INDIVIDUAL APPLIED BASS**

Individual instruction in bass at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2564.

**4574: ADVANCED INDIVIDUAL APPLIED FLUTE**

Individual instruction in flute at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2574.

**4584: ADVANCED INDIVIDUAL APPLIED OBOE**

Individual instruction in oboe at an advanced level. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2584.

**4594: ADVANCED INDIVIDUAL APPLIED CLARINET**

Individual instruction in clarinet at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2594.

**4614: ADVANCED INDIVIDUAL APPLIED SAXOPHONE**

Individual instruction in saxophone at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2614.

**4624: ADVANCED INDIVIDUAL APPLIED BASSOON**

Individual instruction in bassoon at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2624.

**4634: ADVANCED INDIVIDUAL APPLIED HORN**

Individual instruction in horn at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2634.

**4644: ADVANCED INDIVIDUAL APPLIED TRUMPET**

Individual instruction in trumpet at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2644.

**4654: ADVANCED INDIVIDUAL APPLIED TROMBONE**

Individual instruction in trombone at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2654.

**4664: ADVANCED INDIVIDUAL APPLIED BARITONE**

Individual instruction in baritone at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2664.

**4674: ADVANCED INDIVIDUAL APPLIED TUBA**

Individual instruction in tuba at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2674.

**4684: ADVANCED INDIVIDUAL APPLIED PERCUSSION**

Individual instruction in percussion at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2684.

**4714: ADVANCED INDIVIDUAL APPLIED HISTORICAL WIND INSTRUMENTS**

Individual instruction in historical wind instruments at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2714.

**4724: ADVANCED INDIVIDUAL APPLIED HISTORICAL STRING INSTRUMENTS**

Individual instruction in historical string instruments at an advanced level. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2724.

**4734: ADVANCED INDIVIDUAL APPLIED COMPOSITION**

Individual instruction in composition at an advanced level. Majors only. May be repeated. Performance continuation exam required. Variable credit course. Pre: 2734.

**4744: ADVANCED INDIVIDUAL APPLIED CONDUCTING**

Individual instruction in conducting at an advanced level. May be repeated. Consent required. Variable credit course. Pre: 3225, 3226.

**4754: ADVANCED INDIVIDUAL APPLIED RECORDING**

Individual instruction through directed experiential learning in music recording and production at an advanced level. Integration of critical listening, acoustics, audio recording, signal processing, audio mixing, and audio mastering with music theory and performance. An emphasis in hands-on exploratory research in the use of instruments, acoustics, microphones, recording, and production techniques combined with traditional methods and emerging technologies to capture and produce recordings in an artistic manner suitable for use in a senior portfolio. Permission required. May be repeated for a maximum of 12 hours. Variable credit course. Pre: 2754.

**4764: ADVANCED INDIVIDUAL APPLIED ELECTROACOUSTICS**

Individual instruction and completion of a major project in electroacoustic composition, performance, or research, at an advanced level. Repeatable up to three times for a maximum of 3 credit hours. Pre: 3064, 3066. (1H,1C)

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Myers-Lawson School of Construction (Construction Engineering and Management Program)

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[Undergraduate Course Descriptions \(BC\)](#)

[Undergraduate Course Descriptions \(CEE\)](#)

**Director:** Brian Kleiner

**Associate Director:** Christine Fiori

**Principle Faculty:** Y. Beliveau - BC, K. Boyle - REAL, T. Bulbul - BC, J. de la Garza - CEE, C. Fiori - MLSoC, M. Garvin - CEE, D.P. Hindman - SBM, T. Koebel, A. McCoy - BC, T. Mills - BC, V. Mouras - CEE, A. Pearce - BC, G. Reichard - BC, S. Sinha - CEE, J. Taylor - CEE, W. Thabet - BC, and D. Young-Corbett - MLSoC

Web: [www.mlsoc.vt.edu](http://www.mlsoc.vt.edu)

## Overview

The Myers-Lawson School of Construction offers students in the College of Engineering a Bachelor of Science Degree in Construction Engineering and Management. This degree is designed for students who wish to pursue a career in the construction industry. The undergraduate program facilitates the development of critical technical, managerial and professional knowledge and skills required for entry into the construction industry or graduate studies. This body of knowledge includes the decision and optimization methods required to integrate and manage the resources essential to construction operations along with the skills that support the development of safe, ethical, socially responsible, and sustainable solutions for the built environment. The Construction Engineering and Management Program is accredited

by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

Construction managers plan, direct, and coordinate construction projects, including the building of all types of residential, commercial, and industrial structures, roads, bridges, and other public works projects. Construction managers coordinate and supervise the construction process from the conceptual development stage through final construction, ensuring the project is completed within time and budget constraints and is compliant with building and safety codes and other regulations.

The focus of this degree is construction management with engineering and business management as additional major areas of study. The degree retains an emphasis on engineering, with a focus on construction theory and applications, while providing students the opportunity to define the areas of business management they wish to study to complement their career goals.

Coursework capitalizes upon established excellence in the Via Department of Civil and Environmental Engineering, the Department of Building Construction and the Pamplin College of Business. The majority of courses are drawn from existing curricula in Civil Engineering and Building Construction. Complementary courses from the College of Business provide the balance.

Consistent with the general program goal of facilitating development of student competence necessary for entry into the construction industry or graduate school, the School has developed the following program objectives:

- Within a few years of curriculum completion, graduates of the Construction Engineering and Management program should be able to combine skills gained through academic preparation and post-graduation experience so that they can:
  - The intellectual ability to critically assess, analyze, integrate and manage construction engineering problems.
  - An awareness of societal context and how those concerns affect their role as professional engineers and in turn, how their role can enact beneficial change for society.
  - The values-based leadership and team building skills to effectively function in multi-disciplinary, multi-cultural, open-ended engineering activities in a professional and ethical manner, responding dynamically to the social and economic environment that impacts construction.
  - The communication skills to convey technical information to a variety of audiences that include all construction stakeholders, including the general public.
  - The ability and desire to engage in life-long learning in order to perpetually develop their construction engineering skills and professional knowledge, e.g. through graduate study, self-study, continuing education, licensure, mentoring, and leadership in their employment organizations, industry associations and professional societies
- Classroom instruction in the construction engineering and management program is reinforced by instructional laboratories, field trips and guest lectures by leading construction professionals. The department seeks to employ the latest educational technology and innovative teaching methods.
- Students in the School have the opportunity to participate in a summer internship program during which they may apply the concepts learned in the classroom in real world applications. The School encourages all students to participate in professional work experience prior to graduation.

## Class Size Limitation

A proposal to limit enrollment in the BS CEM degree has been approved by University governance. The proposal limits enrollment to 40 students per graduating class.

The contact person for the undergraduate Construction Engineering and Management program is Dr. Christine Fiori, at (540) 239-3389 or e-mail: [cfiori@vt.edu](mailto:cfiori@vt.edu).



# Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Undergraduate Course Descriptions (CNST)

**2104: INTRODUCTION TO THE CONSTRUCTION ENGINEERING AND MANAGEMENT PROFESSION**  
Overview of the construction engineering and management profession specialty areas. Introduction to the undergraduate program of study. Emphasis on the fundamentals of good oral and written communication skills. Professionalism, ethics and legal issues relating to the industry. Emphasis on contemporary issues facing the industry. Introduction to engineering library resources. Pre: ENGE 1216 or ENGE 1104 or ENGE 1114 or ENGE 1434. (2H,2C)

**2984: SPECIAL STUDY**

Variable credit course.

**3134 (BC 3134): TEMPORARY STRUCTURES**

Introduction to temporary structure systems used to support construction operations. Concrete formwork, scaffolding systems, excavation shoring systems, dewatering techniques, and hoisting operations. Assessment of systems, cost, quality, safety, sustainability, and schedule impacts. Pre: (BC 2044 or CEE 3684), (BC 2024 or CEE 3014). (3H,3C)

**3164: CONSTRUCTION HEALTH AND SAFETY**

Introduction to fundamentals of Occupational Health and Safety (OHS) for the construction industry. History of OHS regulation and specific governmental regulations, standards and laws. Health, safety, and environmental hazards identification. Methods of quantifying exposure and estimating risk. Design and prioritization of control solutions to mitigate hazards. Contemporary issues and theoretical frameworks in the field of OHS management relevant to the industry. Prevention through Design, behavior-based safety, different construction project delivery methods, safety climate and culture, control banding, and systems safety. Pre: 2104. (3H,3C)

**3984: SPECIAL STUDY**

Variable credit course.

**4314 (SBIO 4314): DESIGN OF WOOD STRUCTURES**

Analysis and design of wood structures comprised of solid wood and/or composite wood products. Evaluation of mechanical properties of wood materials. Design of individual tension, compression and bending members, and wood-steel dowel connections. Lateral loading design of diaphragms and shearwalls. Pre: SBIO 3314 or CEE 3404. (3H,3C)

**4964: FIELD WORK/PRACTICUM**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (BC)

1214: INTRODUCTION TO BUILDING CONSTRUCTION I

This is an introduction to the world of construction with an overview of the important areas of contracting and the inter-workings of the construction industry. Emphasis is placed on the theory and terminology of the construction industry supplemented with the graphical representation of construction documents and laboratory building experiments. (2H,3L,3C)

1224: INTRODUCTION TO BUILDING CONSTRUCTION II

Continuation of introduction to the world of construction with an overview of the important areas of contracting and the workings of the construction industry. Emphasis is placed on the application of theory, processes and vocabulary of the construction industry supplemented with computer aided graphical representation of construction documents. Grade of C- or better required in prerequisite. Pre: 1214. (2H,3L,3C)

2014: CONSTRUCTION PRINCIPLES I

This course covers the fundamentals of construction technology and processes emphasizing materials, methods, techniques and sequences for the construction of buildings (CSI Divisions 1-6). Planning, scheduling and quantity surveying for the management of construction resources are among the topics studied. Pre: 1224. Co: MATH 1225. (2H,3L,3C)

2024: CONSTRUCTION PRINCIPLES II

This is a continuation of the fundamentals of construction technology and processes emphasizing materials, methods, techniques and sequences for the construction of buildings in CSI divisions 7-16. Planning, scheduling, quantity surveying and control systems for the management of these construction resources are among the topics studied. Pre: 1224, 1214, 2014. Co: 2064. (3H,3C)

2034 (REAL 2034): REAL ESTATE DATA ANALYSIS

Real estate market data and the statistical tools for analyzing data to support decision making. Descriptive statistics and hypothesis testing. Form insights to inform management and investment decisions. Pre: UAP 2004 or REAL 2004. (2H,2C)

2044: BUILDINGS & MATERIALS

Introduction to the theory and applications of building materials. Properties, composition, and characteristics of building materials with particular focus on ferrous and non ferrous metals, concrete, bricks and blocks, timber, glass and plastics. Emphasis on physical behavior of materials under load, including thermal loads, compatibility deformations and material behavior requirements, interaction among different materials, non-destructive/destructive methods for evaluation and testing of construction materials, basic analysis and design applications of major structural components. Pre: 2214 or CNST 2104. (2H,3L,3C)

2064: CONSTRUCTION PRINCIPLES INTEGRATED LAB

Develop a competency in applying construction means and methods as they relate to quantity take-off, cost management, scheduling and resource management in support of a senior capstone project. Co: ARCH 3045, 2024, CEE 3014. (1H,2L,2C)

2094: BUILDING CONSTRUCTION SEMINAR

Exploration of current and relevant topics of inquiry within the construction domain, through engagement, service, and research. Articulates the complex interactions of stakeholders in construction by means of reflection on case studies, panel discussions, and seminars to establish the context, breadth, and impact that construction education shares within larger academic, professional, and societal communities. Can be repeated for a maximum of 3 credit hours. Pass/Fail only. (1H,1C)

#### 2104: BUILDING EFFECTIVE CONSTRUCTION TEAMS

Introduction to tools and techniques to help build effective construction teams including building trust, managing conflict, communicating clear expectations and priorities, accountability, attention to results and commitment towards construction management team mission, embracing innovative change and ethics. Other topics include networking skills, time management tools and effective construction team-based negotiations. Pre: 1224, (COMM 1016 or ENGL 1106). (3H,3C)

#### 2114: INFORMATION TECHNOLOGY IN DESIGN AND CONSTRUCTION

Building delivery and project management improvements through the use of computer applications are explored, including scheduling software, building information modeling (BIM) tools, and virtual design and construction (VDC) simulation software and their corresponding theories and concepts the integrate design and construction. Pre: 1224 or CNST 2104. Co: 2014. (2H,3L,3C)

#### 2214: WHY BUILDINGS STAND UP

Addresses why structures remain stable under various loading conditions. Explores different types of structures and applied loads and analyzes both determinate and indeterminate supported structures. Explores different types of soils and their strength properties. Pre: MATH 1225 or MATH 1025. (3H,3C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3014: BUILDING PHYSICS & ENVIRONMENTAL SYSTEMS

Theory and analysis methods relative to performance of envelope systems and the design and integration of mechanical and electrical building systems. Topics covered include: envelope systems and performance metrics, conceptual and technical design theory, operational principles, and maintenance issues, all necessary for determining the selection of passive and active environmental control systems within a building including: envelope system, heating, active environmental control systems within a building including: envelope system, heating, ventilation, air conditioning, lighting, and acoustical systems. Pre: PHYS 2305. (2H,3L,3C)

#### 3064: BUILDING SYSTEMS TECHNOLOGY LAB

Develop a competency in the application of Building Environmental Systems, through modeling, scheduling, estimating, and experiments in support of a senior capstone project. Co: BC 4004 or CEE 3014. Pre: (2064, PHYS 2305) or (CNST 2104, PHYS 2305). Co: 3114. (1H,2L,2C)

#### 3114: BUILDING SYSTEMS TECHNOLOGY

Emphasis is placed on the integration and physical installation of passive and active environmental control systems including: heating, ventilation, air conditioning, lighting, acoustics, plumbing, and fundamentals of thermal loads. Pre: (2024 or CNST 2104), PHYS 2305. Co: 3064. (2H,3L,3C)

#### 3134 (CNST 3134): TEMPORARY STRUCTURES IN CONSTRUCTION

Introduction to temporary structure systems used to support construction operations. Concrete formwork, scaffolding systems, excavation shoring systems, dewatering techniques, and hoisting operations. Assessment of systems, cost, quality, safety, sustainability, and schedule impacts. Pre: (2044 or CEE 3684), (BC 2024 or CEE 3014). (3H,3C)

#### 3954: STUDY ABROAD

Study abroad in Spain. Variable credit course.

#### 4024 (CEE 4014): ESTIMATING, PRODUCTION, AND COST ENGINEERING

Interpretation of plans and specifications, preparation of construction estimates, and cost control. Methods analysis, resource requirements, and resource costs in building systems, including system components, and in large-scale civil engineering works such as highways, bridges, and hydraulic structures. Pre: 2024, 2064. (3H,3C)

#### 4064: CONSTRUCTION PRACTICE LAB

Application of the business and construction practices related to operation of a construction company to the execution of a senior capstone project. All project management concepts learned in prior courses are applied in the capstone lab experience. Written and oral work is formally presented and critiqued among construction faculty, students, and industry professionals. Pre: 3064. Co: 4434. (1H,2L,2C)

#### 4114: BUILDING INFORMATION MODELING IN DESIGN AND CONSTRUCTION

Introduction to means and methods to enrich the geometric information of a building model with semantic data such as, material, structural and performance values. Concept of interoperability in architecture, engineering and construction industry. Overview of approaches to information modeling such as Standard for the Exchange of Product model data (STEP), Industry Foundation Classes (ifc), Construction Operations Building Information Exchange (COBie) and Green Building XML (gbXML). Key concepts of object-oriented modeling and programming. Pre: 2114. (3H,3C)

#### 4124: DIGITAL CONSTRUCTION & MANUFACTURING

Explore and experiment with construction from the perspective of digital information, computer numerical control (CNC), and computer aided manufacturing (CAM) processes. Tools like 3D scanners, 3D printers, CNC manufacturing techniques and others will be used in a lab setting intended to provide familiarity with these technologies and a sense of their benefits and limitations. Pre: 2114. (2H,3L,3C)

#### 4164: PRODUCTION PLANNING AND PROCESS DESIGN FOR CONSTRUCTION

The course deals with the planning and design of construction processes. Course topics include production systems, behavior of construction systems and workers, the relationships between subsystems in the construction process, queuing systems, process modeling and simulation. The major emphasis is on production and productivity. Production problems that typically occur in construction systems are discussed. The course also explores recent innovations in construction system design such as lean construction and agile construction. Pre: 3114, 3064. (3H,3C)

#### 4314: BUILDING PERFORMANCE & ENERGY MANAGEMENT

Fundamentals of building performance mandates for the built environment, practical means and methods for evaluating building performance metrics. Specific focus on energy resources consumed by thermal, hygrothermal, lighting, and other environmental building systems. Assessment of building energy consumption and analysis of retrofit scenarios through performance evaluation over the entire building life cycle. Pre: 3014. (2H,3L,3C)

#### 4334: SUSTAINABLE BUILDING PERFORMANCE MANAGEMENT

Introduction to means and methods for managing the sustainability of buildings and their performance over the life cycle. Best practices for sustainable projects in the areas of planning/development, site design, project management, energy and water conservation and green building assessment tools and methods; Leadership in Energy and Environmental Design (LEED) rating system; economic analysis of green building alternatives; and implementation planning. Pre: 3064. (3H,3C)

#### 4434: CONSTRUCTION PRACTICE I

Business and construction practices related to operation of a construction company are studied. Construction operation is examined as it relates construction, financial and personnel management. Project management topics studied in this course include permitting, site evaluations, design development and design phase considerations such as preliminary estimates and project constructability. Writing Intensive (WI) course. Pre: (2044 or CEE 3014). Co: 4064. (3H,3C)

#### 4444: CONSTRUCTION PRACTICE II

This course explores and applies the business and construction practices related to operation of a construction company to a capstone experience. Construction operation is examined as it relates to construction, financial and personnel management. Project management topics studied in this course are applied in the corequisite lab. This course is formally designated as a writing intensive course. Formal written and edited and oral presentations are presented and critiqued by the BC faculty team, the writing resource center, students and industry professionals. Pre: 4434. (3H,3L,4C)

#### 4754: INTERNSHIP

Variable credit course.

4974: INDEPENDENT STUDY  
Variable credit course.

4984: SPECIAL STUDY  
Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

## Undergraduate Course Descriptions (CEE)

### 2804: INTRODUCTION TO CIVIL AND ENVIRONMENTAL ENGINEERING

Overview of the civil engineering profession and the undergraduate program of study. The fundamentals of good oral and written communication skills for the Civil Engineer are emphasized. An introduction to engineering library resources is also included. A grade of C- or better required in prerequisites. Pre: ENGE 1024 or ENGE 1215. (3H,2C)

### 2814: CIVIL AND ENVIRONMENTAL ENGINEERING MEASUREMENTS

Introduction to various data measurement issues in civil and environmental engineering, including collection techniques, analysis, error, and statistical evaluation in all sub-disciplines. Spatial measurement topics include GPS, leveling, distance and angular measurement, mapping and topographic surveys, automated data collection, terrain models, earthwork methods, construction surveying, geodesy, and GIS. A grade of C- or better required in pre-requisites. Pre: BC students required to take the BC 1224 pre-requisite, BC and CEM students are exempt from corequisite CEE 2824. CEE students are required to take the ENGE 1216 pre-requisite. Pre: (ENGE 1114 or ENGE 1216 or ENGE 1434 or BC 1224), (MATH 1206 or MATH 1206H or MATH 1226). Co: 2824. (3H,3L,4C)

### 2824: CIVIL ENGINEERING DRAWINGS AND CAD

Introduction to the use of Computer-Aided Drafting (CAD) software in civil engineering, construction, and other land development projects. Interpretation of typical civil engineering drawings. Creation of land development plans, cross section and profile drawings, and detail drawings utilizing computer-aided design and drafting tools. Creation of two- and three- dimensional visualizations of civil engineering, construction, and other land development projects. (1H,1C)

2974: INDEPENDENT STUDY  
Variable credit course.

2984: SPECIAL STUDY  
Variable credit course.

2994: UNDERGRADUATE RESEARCH  
Variable credit course.

### 3014: CONSTRUCTION MANAGEMENT

Fundamental elements involved in managing construction projects. Management structure, construction contracts, equipment and labor productivity, scheduling, quality assurance, and cost control. Junior standing required. (2H,3L,3C)

### 3104: INTRODUCTION TO ENVIRONMENTAL ENGINEERING

Overall view of environmental engineering with emphasis on hazardous waste management, water treatment, wastewater treatment, air pollution and its control, solid waste management, groundwater pollution and environmental regulations. A grade of C- or better required in pre-requisites. Pre: (CHEM 1035 or CHEM 1074), (CHEM 1045 or CHEM 1084), (MATH 1206 or MATH 1206H or MATH 1226 or MATH 2016 or MATH 2024), (PHYS 2305 or PHYS 2205). (3H,3C)

### 3274: INTRODUCTION TO LAND DEVELOPMENT DESIGN

An introduction to the land development design process including site selection and feasibility, environmental considerations, utility layout, grading, stormwater management and integrating planning

with the design of infrastructure to support residential and commercial development. A grade of C- or better in prerequisite. Pre: 2814. (3H,3C)

#### 3304: FLUID MECHANICS FOR CIVIL AND ENVIRONMENTAL ENGINEERING

Hydrostatics; fluid motion; continuity, momentum, and energy equations; viscous effects; applications to pipe networks and hydraulic systems, including open channel flow. Laboratory experiments and demonstrations. A grade of C- or better in pre-requisite ESM 2104. Pre: ESM 2104. (3H,2L,3C)

#### 3314: WATER RESOURCES ENGINEERING

Open channel flow; hydrology; hydraulic modeling; hydraulic machinery and structures; laboratory experiments and demonstrations. A grade of C- or better required in pre-requisite 3304. Pre: 3304. (3H,2L,3C)

#### 3404: THEORY OF STRUCTURES

Fundamental tools and methods of structural analysis: moment-area, slope-deflection, force, and moment-distribution methods. Influence lines. Application to beams, trusses, and simple frames. A grade of C- or better required in pre-requisite ESM 2204. Pre: ESM 2204. (3H,3C)

#### 3424: REINFORCED CONCRETE STRUCTURES I

Behavior and design of reinforced concrete members based on ultimate strength. Beams and slabs in flexure, shear and torsion, development of reinforcement. Columns with axial force plus bending, slenderness effects in columns. A grade of C- or better required in prerequisites. Pre: (3404, 3684) or BC 2044. (3H,3C)

#### 3434: DESIGN OF STEEL STRUCTURES I

Behavior and design of structural steel members and steel-frame buildings, including simple and fixed connections. AISC specifications; elastic theory. Design members to resist tension, compression, bending, torsion; plate girders, composite beams. ESM 3054 may be taken in place of co-requisite CEE 3684. A grade of C- or better in prerequisite. Pre: (3404, 3684) or BC 2044. (2H,3L,3C)

#### 3514: INTRODUCTION TO GEOTECHNICAL ENGINEERING

Engineering properties of soils including their descriptions and classifications, the effects of water, soil strength and compressibility. Introduction to soil stabilization, earth pressures, slope stability, and foundations. A grade of C- or better required in pre-requisites GEOS 2104 and ESM 2204. Pre: ESM 2204, (GEOS 1004 or GEOS 2104 or GEOL 1004 or GEOL 2104). (2H,2L,3C)

#### 3604: INTRODUCTION TO TRANSPORTATION ENGINEERING

Planning, design and operation of transportation systems with emphasis in multimodal transportation techniques and unified system engineering theories to analyze large scale transportation problems. Discussion of Intelligent Vehicle Highway Systems (IVHS) and hands on experience in computer models in transportation operations and planning. Interactions between transportation infrastructure and environmental engineering planning. Junior standing required. (3H,3C)

#### 3684: CIVIL ENGINEERING MATERIALS

Characteristics of constituent materials and the design and behavior of portland cement and bituminous concrete mixtures with demonstrated laboratory experiments. A grade of C- or better required in prerequisites. Pre: CHEM 1035, CHEM 1045, ESM 2204, CEE 2814, (GEOS 2104 or GEOS 1004). (2H,3L,3C)

#### 3804: COMPUTER APPLICATIONS FOR CIVIL AND ENVIRONMENTAL ENGINEERS

Introduction to computer applications in civil and environmental engineering. Integration of design, data management, computer programming and problem solving skills with computer tools and techniques. Topics include systems analysis, optimization, database management, computer programming and data structures. Junior Standing Required. (2H,2L,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4014 (BC 4024): ESTIMATING, PRODUCTION, AND COST ENGINEERING

Interpretation of plans and specifications, preparation of construction estimates, and cost control. Methods analysis, resource requirements, and resource costs in building systems, including system components, and in large-scale civil engineering works such as highways, bridges, and hydraulic structures. A grade of C- or better required in pre-requisite 3014. Pre: 3014. (3H,3C)

#### 4024: CONSTRUCTION CONTROL TECHNIQUES

Techniques used to plan, schedule, and control the Construction Process. Emphasizes manual and computer-based approaches. Focuses on an analytical approach towards the construction process whereby good technical methodologies and solutions are converted to reality through construction practices. A grade of C- or better required in prerequisite. Pre: 3014. (3H,3C)

#### 4074: CONSTRUCTION ENGINEERING: MEANS AND METHODS

Construction means, methods, and equipment used to transform a particular design concept into a completed usable structure or facility. Selection and optimization of individual units as well as the systems needed to produce the required work to the required quality on time and on budget. A grade of C- or better required in prerequisite. Pre: 3014. (3H,3C)

#### 4104: WATER AND WASTEWATER TREATMENT DESIGN

Design of municipal water and wastewater treatment plants. Emphasis on characterization of water and wastewater and physical, chemical, and biological treatment methods. Sludge processing advanced treatment methods and treatment plant hydraulics are considered. A grade of C- or better required in prerequisites. Pre: 3104, 3304. (3H,3C)

#### 4114: FUNDAMENTALS OF PUBLIC HEALTH ENGINEERING

Public health engineering principles for protection against biological and chemical health hazards. Emphasis on major communicable diseases that plague mankind, organisms that cause them, routes of transmission, and engineering methods of control. Appropriate control methods for rural areas and developing countries. A grade of C- or better required in pre-requisite. Pre: 3104. (3H,3C)

#### 4134: ENVIRONMENTAL SUSTAINABILITY - A SYSTEMS APPROACH

Quantitative methods to evaluate environmental sustainability using a systems approach. Sustainability assessment frameworks, orientors and indicators, indicators of sustainable development, green-house gas emissions, renewable energy systems, whole-system design, economic systems and input-output techniques, system dynamics models, emergence and agent-based models. Class project requiring integration of environmental, economic and social systems using system dynamics and agent-based models. Senior Standing. Pre: MATH 2214. (3H,3C)

#### 4144: AIR RESOURCES ENGINEERING Effects, regulation, sources, and control of air pollution.

Application of engineering calculations and models to estimate emissions, predict pollutant concentrations, and design pollution control equipment. Senior standing required. A grade of C- or better required in prerequisites. Pre: 3104 or ENGR 3124 or GEOS 3114 or ENSC 3634. (3H,3C)

#### 4164: ENVIRONMENTAL MICROBIOLOGY

Ecology, physiology, and diversity of soil and aquatic microorganisms; incorporates the significance of these topics within the context of environmental applications such as bioremediation, wastewater treatment, control of plant-pathogens in agriculture, and pollution abatement in natural systems. The laboratory portion of the course will stress methodology development, isolation and characterization of microorganisms from natural and engineered systems, and examination of the roles of microorganisms in biogeochemical cycling. Biology students are exempt from CEE 3104, but must take BIOL 2604 and obtain a C- or higher. A grade of C- or better required in prerequisites. Pre: BIOL 2604 or CEE 3104. (2H,3L,3C)

#### 4174: SOLID AND HAZARDOUS WASTE MANAGEMENT

Introduction to the problems, regulations and techniques associated with the management of solid and hazardous waste. Composition, volume and characterization of the wastes. Design of collection and

disposal systems, including landfills, solidification/stabilization and incineration. A grade of C- or better required in pre-requisite 3104. Pre: 3104. (3H,3C)

#### 4254: MUNICIPAL ENGINEERING

An introduction to the field of municipal engineering. Infrastructure, capital projects, financing, sustainability, disaster planning and response, and plan review for development projects. Senior standing required. (3H,3C)

#### 4264: SUSTAINABLE LAND DEVELOPMENT

An introduction to the modern techniques for developing land while maintaining a focus on long-term sustainability. Topics include site layout, stormwater impact, air quality and microclimate, living resources, LEED and EarthCraft development standards. Pre-requisite: Senior Standing required (3H,3C)

#### 4274: LAND DEVELOPMENT DESIGN

Overview of land development projects including factors, construction practices, legal issues, and government policies. Design project includes feasibility study, engineering evaluation of site, and layout design of lots, buildings, streets, sewers, etc. Interactive graphics and automated drafting. Senior standing in Civil Engineering required. A grade of C- or better required in prerequisite. Pre: 3274. (2H,3L,3C)

#### 4284: ADVANCED LAND DEVELOPMENT DESIGN

Advanced course in land development design focusing on site grading and parking, stormwater management, and erosion control. Reviews project design criteria and applicable municipal and state guidelines. Uses CAD software for design and deliverables. Senior/Graduate standing required. A grade of C- or better required in pre-requisites. Pre: 3274. Co: 4274. (3H,3C)

#### 4304: HYDROLOGY

Precipitation, evaporation, consumptive use, infiltration; stream flow, flood routing; statistical analysis of hydrologic data, flood and drought forecasting, risk analysis, subsurface flow, well hydraulics, introduction to urban drainage design. A grade of C- or better required in pre-requisite. Pre: 3304. (3H,3C)

#### 4314: GROUNDWATER RESOURCES

Fundamentals of groundwater hydrology; flow through porous media, both saturated and unsaturated; flow to wells in both confined and unconfined aquifers; seepage of groundwater to canals and field drains; analysis of aquifer test data to quantify flow and storage parameters; contaminants in groundwater, basic introduction to groundwater modeling. A grade of C- or better required in pre-requisite 3304. Pre: 3304. (3H,3C)

#### 4324: OPEN CHANNEL FLOW

Mechanics of open channel flow, including uniform flow, gradually varied flow, channel transitions, and unsteady flow. Pre: 3314. (3H,3C)

#### 4334: HYDRAULIC STRUCTURES

Hydraulic analysis and design of engineering structures for water control, including reservoirs, dams, spillways, spilling basins, drainage structures, and hydraulic models. A grade of C- or better required in pre-requisite 3314. Pre: 3314. (3H,3C)

#### 4344: WATER RESOURCES PLANNING

Analysis of the water resources planning process and the institutional framework for water resources management. Criteria and procedures for evaluating management alternatives are examined, with emphasis on assessment of economic and environmental impacts. Senior standing required. (3H,3C)

#### 4354: ENVIRONMENTAL HYDROLOGY

Overall view of pollutants movements in surface waters, with emphasis on the role of various hydrologic processes. Natural and constructed wetlands and their use for water quality control. Fundamentals of river hydraulics. Design of flood control channels. Environmental consequences of various types of hydraulic systems. Mitigation, enhancement, and restoration techniques. A grade of C- or better required in pre-requisites 3104 and 3314. Pre: 3104, 3314. (3H,3C)

#### 4384: COASTAL ENGINEERING



Basic wave mechanics principles, surf-zone processes, littoral and sediment processes, shoreline features, astronomical tides, coastal hazards, and functional design of coastal structures. Field trips. Pre: C- or better in 3304. Pre: 3304. (3H,3C)

#### 4404: COMPUTER ANALYSIS OF STRUCTURES I

Formulation of matrix displacement method in a form suitable for program development. Application to trusses and frames. Incorporation of special features such as symmetry, internal releases, support settlements, and influence lines. Initiation of program development. Use of existing programs on the personal computer. A grade of C- or better required in pre-requisite 3404. Pre: 3404. (3H,3C)

#### 4454: MASONRY STRUCTURAL DESIGN

Masonry materials, material testing, material specifications. Structural behavior and design of masonry elements (walls, beams, and columns) and systems used in structures. Construction techniques and the details of masonry construction. Building codes relating to analysis and design of masonry structures. A grade of C- or better required in pre-requisites 3424 and 3684. Pre: 3684, 3424. (3H,3C)

#### 4514: METHODS IN GEOTECHNICAL ENGINEERING

Principles and techniques for characterizing earth materials (soil and rock) for civil engineering projects in various regional environments; with emphasis on the interdisciplinary approach to field exploration and site description through soil mechanics theory, geologic correlations, geophysical methods, in site testing and sampling. A grade of C- or better required in pre-requisite 3514. Pre: 3514. (3H,3C)

#### 4534: EARTH PRESSURES AND FOUNDATION STRUCTURES

Earth pressure theories and their applications to the design of retaining structures, anchors, and excavation bracing. Bearing capacity and settlement of shallow foundations. Types and capacity of deep foundations. A grade of C- or better in pre-requisite 3514. Pre: 3514. (3H,3C)

#### 4544: DESIGN OF EARTH STRUCTURES

Application of geotechnical engineering principles in the design and construction of earth structures. Subsurface models, shear strength of soil, slope stability, earth fills, earth retention, ground improvement, sustainability considerations, geotechnical reporting. Team-based design project. C- or better in 3514. Pre: 3514. (3H,3C)

#### 4554: NATURAL DISASTER MITIGATION AND RECOVERY

Causes, mechanics, classifications, and forces associated with tornadoes, hurricanes, floods, earthquakes, and landslides. Resistance evaluation for existing ground, facilities and structures. Hazard-resistant design of new facilities. Risk and reliability assessment and decision analysis. Strategies and designs for natural disaster risk mitigation. Emergency response for protection of life and property and restoration of lifelines. Includes an interdisciplinary team project. Prerequisite: Senior Standing Required (3H,3C)

#### 4564: INTRODUCTION TO COASTAL AND MARINE GEOTECHNICS

Geotechnical aspects of coastal and marine engineering. Introduction to the coastal zone as a working environment. In-situ geotechnical methods and complementary techniques for investigation. Survey strategies. Local field trips for demonstrating methods, practice and design. A grade of C- or better is required in prerequisite 3514. Pre: 3514. (3H,3C)

#### 4604: TRAFFIC ENGINEERING

Study of traffic and parking characteristics; application of traffic control devices; principles and techniques used to improve the efficiency and safety of traffic flow systems. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4614: ADVANCED CIVIL ENGINEERING MATERIALS

Fundamental properties and the physical and chemical aspects of the structure of Portland cement concretes. Emphasis placed on environmental performance aspects and the application of studies of concrete performance under various exposure conditions. A grade of C- or better required in pre-requisite 3684. Pre: 3684. (3H,3C)

#### 4624: PLANNING TRANSPORTATION FACILITIES

Transportation planning process; urban and regional studies, surveys, data analysis, model development and testing; transportation management, administration, finance, system evaluation, implementation, and integration. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4634: INFRASTRUCTURE CONDITION ASSESSMENT

Infrastructure components and assessment needs; physical and chemical properties of construction materials; deterioration causes, assessment methods, nondestructive evaluation techniques, infrastructure management systems, performance models, service-life-cycle estimates. A grade of C- or better required in pre-requisite 3684. Pre: 3684. (3H,3C)

#### 4644: 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. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4654: GEOMETRIC DESIGN OF HIGHWAYS

Functional design of highways; curves, intersections, interchanges, drainage, and other features involved in highway safety and traffic efficiency. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4664: PAVEMENT DESIGN

Principles underlying methods for the design of various elements of flexible and rigid pavements for highways and airports; climate and traffic effects; pavement management systems. A grade of C- or better required in pre-requisite 3684. Pre: 3684. (3H,3C)

#### 4674: AIRPORT PLANNING AND DESIGN

Airport planning and economic justification, site selection, configuration, development and design of terminal areas, demand forecasting, access, traffic control. A grade of C- or better required in pre-requisite 3604. Pre: 3604. (3H,3C)

#### 4684: TRANSPORTATION SAFETY

Basic principles associated with transportation safety related to humans, vehicles and infrastructure as well as principles of design for safety and practices of empirical evaluation of safety. Principles and practices of accident investigation and injury epidemiology as well as safeguards and control practices. A grade of C- or better required in prerequisite. Pre: 3604. (3H,3C)

#### 4804: PROFESSIONAL AND LEGAL ISSUES IN ENGINEERING

Analysis of the legal, professional, and ethical aspects of engineering practice; introduction to contract law and contract dispute resolution, professional liability, and other aspects of law relevant to engineering practice; professional registration and codes of ethics. Pre: Senior standing in engineering. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

## Nanoscience

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### Overview

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[Undergraduate Course Descriptions \(NANO\)](#)

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**Division Leader:** R. Heflin

**Program Manager:** N. Sullivan

**Principle Faculty:** D. Capelluto, H. Dorn, A. Esker, C. Finkelstein, T. Grove, M. Hochella, G. Khodaparast, G. Liu, T. Long, F. M. Michel, A. Morris, V. Nguyen, H. Robinson, K. Park, and C. Tao

Web: [www.science.vt.edu/ais/nano](http://www.science.vt.edu/ais/nano)

## Overview

The Nanoscience (NANO) program is a joint effort of the departments of Biological Sciences, Chemistry, Geosciences, and Physics. It resides in, and is organized as a division of, the College of Science's Academy of Integrated Science.

Nanoscience, the fundamental study of materials and structures whose size is on the nanometer scale, lies at the very foundation of our world. A nanometer is simply a billionth of a meter, and a typical atom is about 1/10th of a nanometer in size. At this length scale, atoms and molecules follow the laws of quantum physics, and the processes of life (for example, DNA and proteins are naturally-occurring nanoscale materials) and the properties of materials emerge from them. Due to a combination of profound theoretical insights, advances in scientific instrumentation, and massive computing power, we are now capable of imaging and steering single atoms with unprecedented precision, opening a window toward a world in which materials, chemical compounds, devices, and even small organisms can be built atom by

atom and molecule by molecule, tailored toward desired properties and applications. At present, we are only at the dawn of this nanoscience revolution.

Nanoscience courses prepare undergraduates for productive, exciting careers in emerging nanoscale industries. Degree recipients from this program will be ready to contribute to and lead cutting-edge corporate research and development in some of the most important and profitable industries in the world, including information technology, communications, drug development, imaging, and environmental technology.

## Bachelor of Science in Nanoscience

A special brochure describing the division and the B.S. program in Nanoscience is available from the division's webpage or upon request.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

### Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Nanoscience can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

### Minor in Nanoscience

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for requirements toward a minor in Nanoscience.

## Undergraduate Course Descriptions (NANO)

#### 1015-1016: INTRODUCTION TO NANOSCIENCE

Introduction to the interdisciplinary field of nanoscience with perspectives from biology, geoscience, computational science, chemistry, and physics. 1015: Historical perspectives; public perception; economic impact, nanoscience in biology and environment; quantum physics principles; characterization tools; mathematical modeling. 1016: Nanofabrication methods; nanoparticle synthesis and characterization; self-assembly; applications in medicine, electronics, and energy; sustainability. Pre: 1015 for 1016 (3H,3C)

#### 2024: QUANTUM PHYSICS OF NANOSTRUCTURES

Introduction to the quantum physics which governs the properties of matter at the nanoscale. Specific

topics include: Quantization, wave-particle duality, and Schrodinger equation, with applications to the hydrogen atom, periodic crystals, and nanostructures; electron spin, spintronics, and quantum statistical physics. Pre: 1016, (CHEM 1036 or CHEM 1056), (MATH 1206 or MATH 1226 or MATH 2015 or MATH 1026), (PHYS 2306 or PHYS 2206). (3H,3L,4C)

#### 2114: NANOSCIENCE RESEARCH SEMINAR

Readings and discussion of current research areas of nanoscience and nanotechnology including nanofabrication, scanning probe techniques, functional nanomaterials, molecular engineering, bionanotechnology and nanomedicine. Presentations by guest nanoscience faculty on their research activities. Pre: 1016. (1H,1C)

#### 2124: NANOSCIENCE RESEARCH ROTATIONS

Research experiences in campus nanoscience research laboratories. Rotation through three to four laboratories to obtain detailed understanding and hands-on experience of specific research projects. Pre: 2114. (6L,2C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3015-3016: NANOSCALE SYNTHESIS, FABRICATION, AND CHARACTERIZATION

Tools for synthesis, fabrication and characterization of nanomaterials and nanostructures including organic and polymer synthesis, self-assembly, and top-down fabrication as well as methods for identifying their structure and electronic, optical, and thermal properties. 3015: Multiphase macromolecules; electron and scanning probe microscopies; fullerenes, graphene, and nanotubes; optical and electron spectroscopies, thermal analysis; quantum dots and metallic nanoparticles. 3016: Nucleic acid self-assembly; polyelectrolyte complexes; dynamic light scattering and zeta potential; electrostatic self-assembly; self-assembled monolayers; photolithography; electron and ion beam lithography; microcontact printing and nanoimprint lithography. Pre: (2024 or PHYS 3324), (CHEM 2514 or CHEM 2536 or CHEM 2556) for 3015; 3015 for 3016. (3H,3L,4C)

#### 3114: PROFESSIONAL DISSEMINATION OF NANOSCIENCE RESEARCH

Technical skills for dissemination of nanoscience research. Effective use of the nanoscience and nanotechnology literature, use of technologies that support collaborative oral and written communication. Key elements of effective journal publications and conference presentations. Pre: 2124. (1H,1C)

#### 3124: NANOSCIENCE AND THE ENVIRONMENT

Introduction to the connections between nanoscience, nanotechnology, and the environment. Overview of environmental science, why environmental issues are relevant to industry/business/research, naturally-occurring nanomaterials and their roles on Earth, and what is currently known about how manufactured and incidental nanomaterials interact with the atmosphere, hydrosphere, pedosphere, and biosphere. Pre: 1016, (BIOL 2104 or BIOL 2124), (CHEM 1036 or CHEM 1056). (3H,3C)

#### 4124: ADVANCED NANOMATERIALS AND DEVICES

Overview of types of nanomaterials such as nanoparticles, quantum dots, fullerenes, carbon nanotubes, nanowires, graphene, and ultra-thin films. Special nanocomposite materials. Electronic, optical, magnetic, and transport properties of nanomaterials. Interactions between nanomaterials and substrates or interfaces. Applications of nanomaterials for electronics, magnetic storage, and energy-efficient devices. Pre: 3016, MATH 2214. (3H,3C)

#### 4314: NANOMEDICINE

Medical use of nanomaterials including basic, translational, and clinical research. Nanomedical approaches to drug delivery. Diagnostic sensors. Use of nanomedical tools over conventional techniques to treat diseases/disorders. Technical issues associated with medical applications. Bioavailability of

nanotherapies. Use of quantum dots for imaging. Ethical concerns and economic benefits associated with nanomedicine. Pre: 3016, (BIOL 2104 or BIOL 2124). (3H,3L,4C)

4964: FIELD STUDY

Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Neuroscience

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**Executive Director:** H. Sontheimer

**Professors:** M. L. Olsen

**Associate Professors:** S. M. Clinton

**Assistant Professors:** J.M. Bowers, M. Buczynski, G. Hodes, S. Robel, K. Sewall, and C. Thompson

**Affiliated Faculty:** L. Achenie, S. Ball, M. A. Bell, L. Bergamasco, A.S. Bertke, D. Bevan, W. Bickel, R. Blieszner Campbell, S. Cao Guohua, P. Carlier, A. Cate, J. Chappell, P. Chiu, M. Cline, B. Corl, R. Davalos, S. DeLuca, M. Denbow, N. Dervis, R. Diana, H. Dorn, Z. Elias, X. Feng, M. Fox, C. Frank, M. Friedlander, B. Friedman, E. Gilbert, D. Good, R. Gourdie, D. Harrison, G. Howes, R. Jensen, X. Jia, B. Johnson, J. Jones, B. S. Jortner, D. Kelly, B. King-Casas, B. Klein, S. Kojima, S. Laconte, Y. W. Lee, L. Li, E. Marvin, M. McKay, T. Milam, R. Montague, I. Moore, R. Moran, A. Morozov, K. Mukherjee, N. Nanthakumar, M. Orr, R. Panneton, J. Phillips, S. Ramey, K. Roberta, J. Rossmeisl Jr., W. Santos, A. Scarpa, Z. Sheng, G. Simonds, D. J. Slade, A. Smith, M. Theus, G. Valdez, P. VandeVord, S. Verbridge, C. Wyatt, D. Xie, B. Xu, and D. Zallen

**Undergraduate Advisor:** N. Sou

Web: [www.science.vt.edu/neur](http://www.science.vt.edu/neur)

## Overview

The Neuroscience degree draws on faculty and resources from many departments across the campus including but not limited to Animal & Poultry Science, Biology, Chemistry, Economics, Engineering,

Mathematics, Physics, Psychology and Statistics. Graduates of this interdisciplinary program will be proficient in integrating neurogenetics, cellular and molecular neuroscience, neurophysiology, cognitive, computational and systems neuroscience.

The Neuroscience B.S. promotes the advancement and integration of knowledge about the brain and the entire central nervous system, and how they react to and are affected by the vast milieu of stimuli they encounter. The degree program is built on collaborative work and education of students in the classroom, and on the student interactions with researchers and practitioners, providing an unparalleled breadth of neuroscience education at the undergraduate level.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Neuroscience Majors

- Neuroscience B.S. Clinical Neuroscience
- Neuroscience B.S. Cognitive and Behavioral Neuroscience
- Neuroscience B.S. Computational and Systems Neuroscience
- Neuroscience B.S. Experimental Neuroscience

Transfer students should contact the department early, preferably one full semester prior to entrance. This procedure will allow a thorough evaluation of transfer credits and correct placement.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Neuroscience can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (NEUR)

### 1004: NEUROSCIENCE ORIENTATION SEMINAR

An introduction to the field of neuroscience, and academic and career planning for neuroscience majors. Exposure to areas of practice and research, and opportunities for education, training and employment in this field. (1H,1C)

### 2025-2026: INTRODUCTION TO NEUROSCIENCE

Introduction to the fundamental principles of neuroscience. 2025: Structure and function of central nervous system in humans and other animals, signal processing and transmission, development of neural and brain circuits, encoding and transmission of sensory and perceptual information, motor control/movement. 2026:Complex brain processes including learning, memory, emotion, decision making,



social behavior, and mental and functioning. Pre: BIOL 1105 for 2025; 2025 for 2026. (3H,3C)

#### 2035-2036: NEUROSCIENCE LABORATORY

Organization and function of the nervous system. 2035: neuroanatomy, microscopy, intracellular stimulation, extracellular recording, electrophysiology, neurotransmitters, and neuroplasticity. 2036: receptive field, sensation and perception, motor system, simple neural circuitry, neuroendocrine and higher level cognitive processes. Co: 2025 for 2035; 2026 for 2036. (3L,1C)

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3044: CELLULAR AND MOLECULAR NEUROSCIENCE

Fundamental principles of cellular and molecular neuroscience. Methods to study neurochemistry and neurobiology, theoretical and practical issues of relating cellular/molecular structures and functions to higher-level nervous system functioning, and current understanding of cellular/molecular bases of nervous system disorders. Pre: 2026, CHEM 1036. (3H,3C)

#### 3064: EDUCATIONAL NEUROSCIENCE

The conceptual framework of neuroscience of learning and instruction. Methods for studying mind and brain functions and their role in academic success and failure in educational settings. Theoretical and practical issues regarding pedagogy and assessment. Pre: 2026. (3H,3C)

#### 3084: COGNITIVE NEUROSCIENCE

Concepts in cognitive neuroscience. Methods available to study brain and nervous system function, theoretical and practical issues of relating mental functions to biological brain functions. Overview of current understanding of the neural bases of various mental functions (e.g., memory, attention, emotion, decision making). Pre: 2026. (3H,3C)

#### 3144: MECHANISMS OF LEARNING AND MEMORY

Foundation of social interactions in human and non-human: ability to learn and memorize locations, situations, individuals, facts and tasks forms. Cellular and molecular mechanism underlying learning and memory and model systems. Approaches to these processes along with diseases presenting with learning and memory deficits in humans. Pre: 2026. (3H,3C)

#### 3464: NEUROSCIENCE AND SOCIETY

Ethical, legal, and social issues faced by human societies from the perspective of neuroscience. Broader questions about ethical and social constructs including consciousness, personhood, cognitive enhancement, free will, and death. Research in neuroscience to issues in medicine, research, law, criminology, public health, and the arts. Junior Standing. (3H,3C)

#### 3554: NEUROSCIENCE RESEARCH AND PRACTICAL EXPERIENCE

Integration of the interdisciplinary fields of neuroscience: includes the conceptual frameworks and theories of neuroscience spanning molecules to behavior, the methods available to study nervous system structure and function from molecules to behavior, theoretical and practical issues of linking these lower-level structures and processes to higher-level neurological and psychological functions, and the latest applications and technologies for translating neuroscience into more effective interventions and treatments. Practical experience includes literature review research and writing, data analysis and interpretation, written and oral presentation, and site-specific training. Pre: 2026. (3H,3C)

#### 4034: DISEASES OF THE NERVOUS SYSTEM

Common brain and Central Nervous System (CNS) disorders ranging from trauma to autism. Genetic, molecules and cellular changes in disease. Therapeutic implications and development of novel drugs. Challenges in drug discovery and implementation of personalized medicine. Ethical issues regarding

genetic findings. Pre: 2026. (3H,3C)

#### 4044: NEUROSCIENCE SENIOR SEMINAR

Integration of methods and results from cutting-edge interdisciplinary neuroscience research; theoretical and practical issues when linking molecular/cellular structures and processes to higher-level neurological and psychological functions. Pre: 3044, 3084. (3H,3C)

#### 4084: DEVELOPMENTAL COGNITIVE NEUROSCIENCE

Concepts in developmental cognitive neuroscience. Methods available to study development of brain and nervous system function. Relating developmental change in mental functions to development of biological brain functions. Advancements in research and practice regarding developmental basis of neurological and mental functions (e.g., memory, attention, emotion). Pre: 3084. (3H,3C)

#### 4454 (ECON 4454) (PSYC 4454): NEUROECONOMICS

Neural processes related to reward, learning, reflection, delay of gratification, and social interaction. Clinical uses of neuroeconomics research techniques. Implications of neuroeconomics in economics, policy, law and business. Pre: 2026 or ECON 3104. (3H,3C)

#### 4544: SYNAPTIC STRUCTURE AND FUNCTION

Synapse morphology and function, central versus peripheral synapses, site of action of many therapeutic drugs and substances of abuse, synaptic pruning and failure. Changes in synaptic structure and function during development and in diseases. Pre: 2026. (3H,3C)

#### 4594: CLINICAL NEUROSCIENCE IN PRACTICE

Clinical approaches to surgically treat stroke, trauma, spinal cord injuries and brain tumors. Expected outcomes and therapeutic limitations. Surgical procedures in operating rooms. Patient follow-up and outcomes. Medical emergencies and appropriate professional responses. Ethical issues regarding health care, disparity, life and death decisions. Medical profession exploration. Neuroscience majors, junior standing. Pre: 2026. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Philosophy

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**Head:** Douglas Lind

**Professors:** J. C. Klagge, J. C. Pitt, and D. Lind

**Associate Professors:** L. Patton and M. Moehler

**Assistant Professors:** B. Jantzen, K. Trogdon, S. Hirji, and D. Wodak

**Visiting Assistant Professors:** G. Novack, N. Rockwood, and T. Parent

**Adjunct Professor:** J. Garrison (School of Education)

**Career Advisor:** J. C. Pitt (231-4564)

**Emeritus:** R. Burian, H. B. Miller, P. Talbutt, and D. Mayo

Web: [www.phil.vt.edu](http://www.phil.vt.edu)

## Overview

Courses in philosophy aim at critical understanding and rigorous evaluation of the concepts underlying our views concerning the nature of reality, what sorts of things there are, what can be known, what is of value, and what people ought to do and to aim at. The department offers programs leading to the B.A. and to the M.A. Philosophy majors receive a strong liberal arts education and are prepared for careers that require a broad perspective and independent judgment. They are prepared for graduate work in a variety of scholarly and professional fields. An undergraduate philosophy major is especially appropriate for the student considering law school, medical school, or other professional schools. In addition, philosophy may be chosen as a minor.

Philosophy majors must complete the college core and the Curriculum for Liberal Education and successfully complete at least 30 hours in philosophy, including three courses in the history of philosophy,

and 3505 (Symbolic Logic). At least 9 of the 30 hours must be at the 3000 level or above, with at least 3 of these hours at the 4000 level. In addition, a strong second area of concentration is chosen by each major student; it will consist of at least 18 credit hours [including courses as part of the Liberal Education requirements] in one discipline or in a set of closely related disciplines other than philosophy. At least 6 of these 18 hours must be at the 3000 level or above. Also, the department has recently added a new Pre-Medical Professions Option in Philosophy. See Philosophy Department web site for specific details. A double major is possible with any of several other curricula.

Philosophy minors must complete at least 18 hours of philosophy, including one of 1504 or 3505, 6 hours selected from courses at the 3000 or 4000 level and an additional 3 hours from either the 3000-4000 level or in the history sequence (2115, 2116, 2125, 2126).

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in philosophy.

Satisfactory progress requirements toward the B.A. in philosophy can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (PHIL)

### 1204: KNOWLEDGE AND REALITY

Examines the questions: What is the nature of reality? How do I know what is real and what is misleading appearance, error, or illusion? What is knowledge? How do I find out who I am and how I relate to the world around me? (3H,3C)

### 1304: MORALITY AND JUSTICE

A critical survey of theories concerning human nature, the meaningful life, and the moral evaluation of actions, persons, and institutions. Theories will be applied to such issues as abortion, justice, and moral problems faced by professionals. (3H,3C)

### 1504: LANGUAGE AND LOGIC

Basic concepts in logic and critical thinking: argument, validity, deduction and induction, logical form, formal and informal fallacies. Introduction to the logic of truth functions and of categorical statements. Critical analysis of arguments in ordinary language. (3H,3C)

### 2115,2116: ANCIENT THROUGH MEDIEVAL PHILOSOPHY

Western philosophical thought through the medieval period. 2115: ancient philosophy, including Presocratics, Socrates, Plato, and Aristotle. 2116: main trends in Post-Aristotelian Greek and Roman philosophy and medieval philosophy, including Augustine, Aquinas, and Ockham. (3H,3C)

### 2125,2126: HISTORY OF MODERN PHILOSOPHY

Western philosophical thought from Descartes through Kant. 2125: 17th Century Philosophy, including Descartes, Spinoza, Leibniz, and Locke. 2126: 18th century philosophy, including Berkeley, Hume and Kant, with special attention to significant predecessors. (3H,3C)

### 2304: GLOBAL ETHICS

Ethical issues in international context. Application of the principles of moral theory to such issues as the obligations of richer nations toward poorer ones, cultural and other forms of relativism, emigration and immigration, nationalism, war, deterrence, intervention, environmental degradation, preservation of natural diversity, and responsibilities toward future generations. (3H,3C)

### 2605,2606: REASON AND REVOLUTION IN SCIENCE

Study of philosophical approaches to understanding and justifying modes of human reasoning both in

science and everyday life. 2605: nature of theory confirmation and falsification; 2606: justifying changing paradigms of human inquiry. (3H,3C)

2894 (ECON 2894) (PSCI 2894): INTRODUCTION TO PHILOSOPHY, POLITICS, AND ECONOMICS  
Integrated study of philosophy, politics, and economics. Trains students to make decisions that are not only economically sound, but also socially, ethically, and politically informed. Topics include: models of human nature, rational choice theory, social cooperation, distributive justice, markets, and democracy. (3H,3C)

2964: FIELD STUDY  
Pass/Fail only. Variable credit course.

2974: INDEPENDENT STUDY  
Variable credit course.

2974H: INDEPENDENT STUDY  
Variable credit course.

2984: SPECIAL STUDY  
Variable credit course.

3015,3016 (PSCI 3015, 3016): POLITICAL THEORY  
Analysis of the fundamental ideas in the history of political theory. 3015: Plato to the 17th century. 3016: late 17th century to the present. Pre: PSCI 2014. (3H,3C)

3024: PHILOSOPHICAL MOVEMENTS  
This course focuses on the assumptions and methods of one or more contemporary or historically important movements in philosophy such as Existentialism, Feminism, Local Positivism, Phenomenology, Pragmatism, or Naturalism. Pre-requisite: 3 Philosophy credits required. May be repeated twice for credit under different topics, up to 9 hours total. (3H,3C)

3314: ETHICAL THEORY  
Careful examination of some important historical or contemporary ethical theories. Includes coverage of such topics as the assessment of character and action, the foundations of ethical theories, their justification, their relationship to scientific theories, and their objective or subjective status. 3 Philosophy credits required. (3H,3C)

3324: BIOMEDICAL ETHICS  
Philosophical analysis of ethical issues in medicine and biotechnology, such as problems arising in connection with the relations between physicians and patients, the challenges of cultural diversity, practices surrounding human and animal research, decisions about end of life care, embryonic stem cell research, genetic engineering, biotechnological human enhancement, and social justice in relation to health-care policy. (3H,3C)

3414: AESTHETICS  
Studies the basic concepts used in the analysis and evaluation of art works; considers problems of art criticism as treated within major types of aesthetic theory. (3H,3C)

3454: PHILOSOPHY OF RELIGION  
A consideration of religious belief and its justification with attention to such philosophical issues as the nature and existence of God, the problem of evil, and the notion of faith. (3H,3C)

3505-3506: MODERN LOGIC AND ITS DEVELOPMENT  
Logic and logical theory and the history of its development. 3505: Validity of arguments. Syllogistic logic from Aristotle to modern times. Deductive methods in truth functional and quantificational logic through the theory of identity. Translation from English into symbolic form. 3506: Metalogic and the history and philosophy of modern logical theory. Decidability and undecidability, completeness and incompleteness of formal systems. Developments from Cantor to Goedel. Must have 3505 to take 3506. (3H,3C)

#### 4015,4016: SPECIAL TOPICS IN PHILOSOPHY

Critical examination of special issues of current philosophical interest. 3 Philosophy credits required. (3H,3C)

#### 4204: PHILOSOPHY OF MIND

Current issues in the philosophy of mind such as relation of mind and body, status of the mental, knowledge of one's own and other minds, personal identity, consciousness, mentality of animals and machines, topics in the philosophy of psychology. 3 Philosophy credits required. (3H,3C)

#### 4214: METAPHYSICS

Examination of some of the 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. 3 Philosophy credits required. (3H,3C)

#### 4224: EPISTEMOLOGY

Theory of knowledge. Is all knowledge based on experience? Does knowledge have a foundation? Can knowledge of the present and the nearby give us reasons for beliefs about the future, the past, or about events far away? 3 Philosophy credits required. (3H,3C)

#### 4304: TOPICS IN SOCIAL & 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. 3 Philosophy credits required. (3H,3C)

#### 4324 (MGT 4324): BUSINESS AND PROFESSIONAL ETHICS

An inquiry into the fundamental norms of conduct in business and other professions and their justification in relation to the most important ethical theories. Special attention will be given to moral problems such as the ethics of hiring and firing, bribery, and professional responsibility to society. (3H,3C)

#### 4334: JURISPRUDENCE

An examination of the nature of law and legal systems with attention to traditional theories of law and to such topics as judicial decision and discretion, law and morality, the justification of legal coercion. 3 Philosophy credits required. (3H,3C)

#### 4514: SPECIAL TOPICS IN LOGIC

Topics that build upon a knowledge of classical deductive logic: extensions of classical logic, alternatives to classical logic, philosophy of logic, and philosophy of language. Topics to be announced each semester course is offered. Pre: 3505. (3H,3C)

#### 4604: PHILOSOPHY OF BIOLOGY

This course is designed primarily for students of biology or philosophy students with a strong interest in biology. 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. (3H,3C)

#### 4614: PHILOSOPHY OF SCIENCE

An examination of the structure and methodology of science as well as key concepts such as explanation, confirmation, realism, and instrumentalism. One year of science and 3 philosophy credits required. (3H,3C)

#### 4884 (ECON 4884) (PSCI 4884): ADVANCED TOPICS IN PHILOSOPHY, POLITICS, AND ECONOMICS

Advanced topics at the intersection of philosophy, politics, and economics. Core methods and concepts: utility theory, game theory, social choice theory, public choice theory, markets, justice, and democracy. Senior research project. Pre: Senior standing. Pre: 2894 or PSCI 2894 or ECON 2894. (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY  
Variable credit course.

4974H: INDEPENDENT STUDY  
Variable credit course.

4984: SPECIAL STUDY  
Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

4994H: UNDERGRADUATE RESEARCH  
Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Physics

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**Chair:** Leo Piilonen

**Professors:** L. N. Chang<sup>1</sup>, J.R. Heflin, J. J. Heremans, P. Huber, J. M. Link, D. Minic, P.R. Montague, S.K. Mun, L. E. Piilonen, M. L. Pitt, M. J. F. Pleimling, E.R. Sharpe, J. H. Simonetti, U. Tauber, and R. B. Vogelaar

**Associate Professors:** N. Arav, S. Economou, G. Khodaparast, K. Park, H. Robinson, V. W. Scarola, V. Soghomonian, and T. Takeuchi

**Assistant Professors:** L. Anderson, E. Barnes, S. Cheng, D. Farrah, J. Gray, S. Horiuchi, C. Mariani, W. Mather, V. Nguyen, and S. Petty

**Research Assistant Professor:** K. Wong

**Adjunct Professors:** O. Benhar, R. Blankenbecler, C. D. Bowman, Z. Chang, Y. Kwon, Y. Liang, W. Louis, G.R. Myneni, and Z. Toroczka

**Career Advisor:** A J.R. Heflin

**Affiliated Faculty:** L. Asryan<sup>2</sup>, S. Eubank<sup>3</sup>, L. Guido<sup>4</sup>, S. Jung<sup>8</sup>, R. Mueller<sup>6</sup>, A. Onufriev<sup>5</sup>, M. Paul<sup>6</sup>, and J. Xing<sup>7</sup>

<sup>1</sup>Dean of the College of Science

<sup>2</sup>Regular appointment with Material Science and Engineering

<sup>3</sup>Regular appointment with the Virginia Bioinformatics Institute

<sup>4</sup>Regular appointment with Materials Science & Engineering and Electrical & Computer Engineering

<sup>5</sup>Regular appointment with Computer Science

<sup>6</sup>Regular appointment with Mechanical Engineering

<sup>7</sup>Regular appointment with Biological Sciences

<sup>8</sup>Regular appointment with Engineering Science & Mechanics

Web: [www.phys.vt.edu](http://www.phys.vt.edu)



## Overview

The physics curriculum is designed to provide a broad foundation in the physical sciences, as well as specialized training in classical and modern physics, and it may lead to either a B.S. or a B.A. An honors student may also qualify for a five-year program leading to both the B.S. and M.S. Experimental opportunities are available in such fields as fundamental particle physics, nuclear physics, condensed matter physics, laser optics, and astronomy. Students are encouraged to participate with faculty members in undergraduate research projects.

Liberal emphases in the physics curriculum permit students to give special attention to those aspects of the discipline they prefer and enable them either to pursue a traditional course of study as preparation for joining the technical staffs of industries or government laboratories, or for graduate studies in physics or astronomy (B.S.); or to pursue an interdisciplinary course of study with a strong background in physics (B.A.).

A handbook that includes sample curricula for emphases in astrophysics, chemistry, computer science, education, electrical engineering, finance, geophysics, materials science, mathematics, physics education, pre-health, and pre-law is available from the department on request.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Majors

- Physics B.S. (Outstanding students may also elect to complete the requirements for a B.S. "in honors". A description of this honors program in physics is included in the handbook indicated above.)
- Physics B.A.
- Physics B.A. Physics Education Option
- Physics B.A. Pre-Health Option
- Physics B.A. Pre-Law Option

The department also offers the M.S. and Ph.D. in physics (see the Graduate Catalog).

Transfer students should contact the department early, preferably one full semester prior to entrance. This procedure will allow a thorough evaluation of transfer credits and correct placement.

The department participates in the Cooperative Education Program in which a student may alternate through two successive years a semester of study with a semester of professional employment in his/her discipline; these two years normally replace the student's sophomore year. Additional information on the program is included in the "[Academics](#)" section in this catalog and in the handbook indicated above.

## Minors

A student may obtain a minor in physics or astronomy by registering with the department and successfully completing the approved minor requirements in effect at the time of graduation. Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for minor requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. and B.A. in Physics can be found on the major checklist by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (PHYS)

### 1055,1056: INTRODUCTION TO ASTRONOMY

Survey course covering astronomy topics ranging from the solar system to the universe. 1055: apparent sky motions, telescopes, properties of the planets, structure and evolution of the solar system. (3H,3C)

### 1155,1156: ASTRONOMY LABORATORY

Simulation of apparent sky motions; observations of planets, stars, and nebulae with quantitative analysis; long term observations of sky changes; analysis of images; laboratory experiments of astrophysical relevance. Co: 1055 for 1155; 1056 for 1156. (3L,1C)

### 2074: HIGHLIGHTS OF CONTEMPORARY PHYSICS

Conceptual overview of fundamental modern thinking in physics. Presents the key ideas and philosophical/ethical aspects of the most important developments in modern physics, such as quantum mechanics, relativity, particle physics, cosmology, etc., and discusses their impact on our understanding of the universe and our position in it. (3H,3C)

### 2114: BLACK HOLES

Properties of black holes and the astronomical evidence for their existence. Black holes as the most simple objects in the Universe. Algebra-based physical nature of black holes, space, time and gravity through Newton's and Einstein's theories. Predicted types and properties of black holes, the deaths of stars, detecting black holes, black holes in the centers of galaxies, and singularities. (3H,3C)

### 2205-2206: GENERAL PHYSICS

For students in curricula other than physical sciences, mathematics, or engineering, who have not studied calculus. 2205: Mechanics, optics, acoustics. 2206: Electromagnetism, thermodynamics, relativity, and topics in modern physics. Pre: MATH 1016 or MATH 1016H or MATH 1025 or MATH 2015 or MATH 1026 or MATH 1205 or MATH 1205H or MATH 1525 or MATH 1535 or MATH 1225 or MATH 1225H for 2205; 2305 or 2205 for 2206. (3H,3C)

### 2215-2216: GENERAL PHYSICS LABORATORY

Lab experiments dealing with basic laws and techniques of physics; designed to illustrate topics covered in General Physics, 2205-2206. Should be taken concurrently and in phase with lecture sequence, 2205-2206. Co: 2205 for 2215; 2206 for 2216. (3L,1C)

### 2305-2306: FOUNDATIONS OF PHYSICS I

First two semesters of the three-semester introductory sequence for students in physical sciences and mathematics. Includes classical mechanics, gravity, and waves (2305); heat, electricity, magnetism and

optics (2306); laboratory work. 3304 is the concluding semester of the sequence. Co: PHYS 2325 or (MATH 1206 or MATH 1206H or MATH 1226) for 2305. Pre: (MATH 1205 or MATH 1205H or MATH 1225) or (MATH 1206 or MATH 1206H or MATH 1226) for 2305; (MATH 1206 or MATH 1206H or MATH 1226), PHYS 2305 for 2306. (3H,3L,4C)

#### 2325-2326: SEMINAR FOR PHYSICS MAJORS

Introduction to the field of physics and to the Physics Department. Overview of modern physics topics such as special relativity, quantum mechanics, condensed matter, nuclear, and particle physics. Presentation of research activities in the department. Also provides more in-depth discussion of and math preparation for topics in 2305-2306. For physics majors. Co: 2305 for 2325; 2306 for 2326. (1H,1C)

#### 2404: PHYSICS OUTREACH

Service learning through teaching. An early field experience for physics students who are interested in physics education. Visit local schools and host campus visits to teach K-12 students fundamental physics concepts by performing physics demonstrations and activities. Learn successful communication techniques, lead classroom discussions, and utilize pedagogical content knowledge to effectively organize physics presentations to the general public. Repeatable (no maximum). Variable credit course. Co: 2305.

#### 2504: MATH METHODS IN PHYSICS

Applications of mathematical methods to physics. Topics include spatial coordinate systems, linear algebra techniques in coupled motions, series approximations of solutions to physical systems, extremum problems in physics, differential equations in mechanics, integration in two and three spatial dimensions, probability theory in thermal physics. Co: 2306, (MATH 2214 or 2214H) and (MATH 2224 or 2204 or 2204H). Pre: 2305. Co: MATH 2214, MATH 2224, 2306. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 2994H: UNDERGRADUATE RESEARCH

Honors Variable credit course.

#### 3154: OBSERVATIONAL ASTROPHYSICS

Telescopic observations of the moon, planets, stars, interstellar medium, and galaxies; astrophotography; digital imaging. Telescopes; virtual observing techniques and instruments; photographic and digital imaging systems. Astronomical data reduction and interpretation; digital image processing. Prior credit for Phys 2154 precludes credit for 3154. Pre: 1156. (1H,3L,2C)

#### 3254: ENRICHED PHYSICS OUTREACH

Design and implementation of physics lesson plans for K-12 students at local schools and campus visits. Creation of inquiry-based, student-centered physics lessons which motivate and educate students of all ages. Development of activities and experiments to engage students in being scientists. Co: 2306. (3H,3C)

#### 3314: INTERMEDIATE LABORATORY

Characteristics of common instrumentation and basic circuits, methods of producing good practices in data gathering, recording, and analysis. (2H,3L,3C)

#### 3324: MODERN PHYSICS

Photons and their interactions with matter, wave-particle duality, Heisenberg uncertainty principle, Schrodinger's equation of motion, hydrogenic and multi-electron atoms, Pauli exclusion principle, molecules, solids, nuclei, elementary particles. Includes lab work. MATH 4544 can be substituted for co-requisite MATH 2214 or 2214H. Co: 2504, MATH 2214 or MATH 2214H. Pre: 2306. Co: MATH 2214, 2504. (3H,3L,4C)

#### 3355-3356: INTERMEDIATE MECHANICS

Formal aspects of classical mechanics and dynamics. Topics include Newtonian, Lagrangian and Hamiltonian theory applied to non-relativistic systems in one, two, and three dimensions, relativistic dynamics, linear algebra applied to coupled many-body motion, small oscillations, and rigid body motion. Pre: (MATH 1224 or MATH 2204 or MATH 2204H), (MATH 2214 or MATH 2214H), PHYS 2305, PHYS 2306, PHYS 2504 for 3355; 3355 for 3356. (3H,3C)

#### 3405-3406: INTERMEDIATE ELECTRICITY AND MAGNETISM

Electrostatics, multipoles, Laplace's equation, and dielectric media. Magnetostatics, magnetic media, and electromagnetic induction. Maxwell's equations, electromagnetic energy, waves, and radiation. Must meet pre-requisites and have a grade of C or better in each of 2305-2306 sequence. Pre: (MATH 2214 or MATH 2214H), PHYS 2305, PHYS 2306, PHYS 2504 for 3405; 3405 for 3406. (3H,3C)

#### 3655,3656: INTRODUCTION TO ASTROPHYSICS

Application of elementary physical laws to determine dimensions, masses, luminosities, structures, and evolution of astronomical objects and the universe as a whole. Emphasis is on quantitative derivation. Pre: 2306. (3H,3C)

#### 3704: THERMAL PHYSICS

Introduction to the concepts, formalism, and applications of classical and quantum statistical mechanics, including thermodynamics. Co: 2504, (MATH 2214 or 2214H). Pre: 2306, 3324. Co: MATH 2214, 2504. (3H,3C)

#### 4224: PHYSICS TEACHING AND LEARNING

Seminar course on how people learn and understand key concepts in physics to encourage more effective teaching strategies. Discussions of readings in physics, physics education research, and cognitive science. Recognition of common student preconceptions of physics concepts and identification of strategies which help to elicit conceptual change. Field work teaching precollege or college students. For students interested in teaching and learning physics, graduate teaching assistants, and undergraduate learning assistants. Pre: 2306. (2H,2C)

#### 4315-4316: MODERN EXPERIMENTAL PHYSICS

Representative apparatus, techniques, and phenomena of contemporary research. Includes electrical measurements, computers, thermometry, vacuum deposition, machine shop, nuclear spectra, experimentation related to major developments of modern physics. Pre: 3314 for 4315; 3314, 4315 for 4316. (6L,2C)

#### 4455-4456: INTRODUCTION TO QUANTUM MECHANICS

Experimental bases; postulates; conservation theorems and symmetry; one-dimensional and two-dimensional problems; angular momentum and problems in three dimensions; matrix mechanics and spin; applications to atomic and molecular physics; perturbation theory; scattering. Pre: 3356 for 4455; 4455 for 4456. Co: 3406 for 4455. (3H,3C)

#### 4504: INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

Structure and properties of atomic nuclei and elementary particles, theoretical interpretations based on elementary quantum mechanics. Symmetries; various nuclear models; interactions at small distances; classification of elementary particles. Consent required. Co: 4456. (3H,3C)

#### 4554: INTRODUCTION TO SOLID STATE PHYSICS

Basic concepts of solid state physics including crystal structure, lattice vibrations, electron states, energy bands, semiconductors, metals. Consent required. Co: 4456. (3H,3C)

#### 4564: POLYMER PHYSICS

Introduction to the field of polymer physics. Statistical descriptions of polymers based on Brownian motion and random walk models. Conformations and single chains. Thermodynamics of polymer mixtures, solutions, and melts. Properties of polymer networks. Polymer dynamics in both melt and solution states. Pre: 2306. (3H,3C)

#### 4574: NANOTECHNOLOGY

Introduction to 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. Pre: 2205, 2206 or 2305, 2306. (3H,3C)

#### 4614: OPTICS

Fundamentals of the ray, wave and quantum models of light, and topics in modern optics with contemporary applications. Pre: 2306, MATH 2214, (MATH 2224 or MATH 2204 or MATH 2204H). (3H,3C)

#### 4624: OPTICS LABORATORY

Laboratory experiments dealing with ray and wave optical phenomena designed to illustrate and complement the principles covered in OPTICS Phys 4614. Physics majors are required to take 4624 concurrently with the lecture course 4614. Co: 4614. (3L,1C)

#### 4654: MODERN COSMOLOGY

Survey of our current understanding of the origin, evolution, and fate of the Universe. Observational evidence behind the idea of the hot Big Bang, including the linear velocity-distance law, the existence of the cosmic microwave background, and the arguments for dark matter. Physics of a dynamic, expanding Universe via the Friedman-Lemaitre-Robertson-Walker metric. Physical principles to determine the conditions in the early Universe, introducing the idea of inflation. Mechanisms driving the origin and evolution of galaxies and large-scale structures. Pre: 3656. (3H,3C)

#### 4674: INTRODUCTION TO GENERAL RELATIVITY

Introduction to 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 space-time; black holes; cosmology; Einstein's gravitational field equations; gravitational waves and relativistic stars. Pre: MATH 2214 or MATH 2214H or MATH 2514, PHYS 3356. Co: 3406. (3H,3C)

#### 4714: INTRODUCTION TO 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. Pre: 2206 or 2306. (3H,3C)

#### 4755-4756: INTRODUCTION TO COMPUTATIONAL PHYSICS

Survey of computational methods in physics. 4755: Applications in physics of curve fitting, numerical calculus, ordinary and partial differential equations, numerical methods for matrices, spectral analysis, and N-body systems. 4756: Investigation of physical systems using Molecular Dynamics simulations, Monte Carlo simulations, genetic algorithm and numerical renormalization. Introduction to advanced techniques, as for example density matrix renormalization group method, matrix product state approach, smoothed particle hydrodynamics, and density functional theory. Pre: 2306, CS 1044 for 4755; 4455, 4755 for 4756. (3H,3C)

#### 4774: INTRO TO PHYSICS OF GALAXIES

Survey of our current observational and theoretical understanding of the formation and evolution of galaxies. Observational review of galaxy sizes and compositions, including the origin of the Hubble sequence. Physical description of a galaxy via distribution functions and stellar orbits. Time evolution of the distribution function. The Schwarzschild method for determining orbits. The physics of active galaxies. Pre: 3656. (3H,3C)

4964: FIELD STUDY

Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

### Plant Pathology, Physiology, and Weed Science

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#### Overview

#### [Undergraduate Course Descriptions \(PPWS\)](#)

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**Head:** Boris A. Vinatzer

**Professors:** J. F. Derr, J. D. Eisenback, E. A. Grabau, R. Grene, C. Hong, C. S. Johnson, D.B. Langston Jr., J. M. McDowell, D. G. Schmale III, B. A. Vinatzer, J. H. Westwood, and K. S. Yoder

**Associate Professors:** S. D. Askew, M. Balota, J. N. Barney, A. B. Baudoin, E. Collájková, J. G. Jelesko, G. Pilot, and S. L. Rideout

**Assistant Professors:** C. W. Cahoon, M. L. Flessner, D. C. Haak, H. L. Mehl, M. Nita, and X. Wang

**Special Research Faculty:** E. A. Bush, D. S. McCall, and S. Y. Park

**Instructor:** M. A. Hansen

Web: [www.ppws.vt.edu](http://www.ppws.vt.edu)

### Overview

The primary mission of the department is research, extension and graduate education in the areas of plant pathology (nature, biology and control of plant diseases), plant physiology, and weed science (weed biology and control, action of herbicides). No undergraduate majors are offered in these areas, but the department does offer an undergraduate minor in Plant Health Sciences, focused on managing plant health in response to a variety of biotic and abiotic threats. These threats include pathogens, weeds, insects and environmental stressors (drought, heat, cold, pollutants, nutrients) that impact our food crops, forests, and landscape plants; students in the Departments of Crop and Soil Environmental Sciences, Horticulture, Biological Sciences, or Biochemistry are most likely to enroll in this minor, but students in other departments may participate as well if they have the prerequisite freshman biology and chemistry courses. Consult the department office (413 Price) or web site ([www.ppws.vt.edu](http://www.ppws.vt.edu)) for more information

on the minor. Several undergraduate courses offered by the department are also required or electives for students in agricultural or biological majors. These courses are designed to furnish basic knowledge of the nature, diagnosis, and control of plant diseases; identification, biology, and control of weeds; plant metabolism, nutrition, molecular biology, and growth regulation; and modern pest management and pesticide usage.

The department offers graduate programs leading to M.S. in the life sciences and Ph.D. in plant pathology, plant physiology and weed science. A non-thesis M.S. program in plant protection and pest management is also available (see [Graduate Catalog](#)).

## Undergraduate Course Descriptions (PPWS)

### 2004: MYSTERIOUS MUSHROOMS, MALICIOUS MOLDS

This course is an examination of the fungi and their close relatives, with special attention to their roles in the natural world and in shaping the course of human history. Emphasis is placed on the historical and practical significance of fungi as sources of medicine, pathogens of plants and animals, rotters and decayers of organic matter, makers of food and drink, manufacturers of dangerous toxins, and producers of mind-altering chemicals. A student must have a basic understanding of biology. (3H,3C)

### 2104: PLANTS, GENES, AND PEOPLE

Explores how and why humans have manipulated plant genomes from prehistory through the current genomic era by examining the scientific, cultural, historical, and legal aspects of plant gene management in both conventional and transgenic crops. Pre: BIOL 1005 or BIOL 1105. (3H,3C)

### 2964: FIELD STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3504: PLANT PHYSIOLOGY AND THE BIOTIC ENVIRONMENT

Course explores how both agricultural and non-crop plants grow, develop, and respond to biotic environmental influences. Topics include symbiotic and pathogenic microorganisms, herbivores, phytoremediation, parasitic plants, and weeds. The scope ranges from biochemical, cellular, tissue, to whole plant physiology. Course includes an experimental project in plant physiology on one of the topics. Pre: (BIOL 1006 or BIOL 2304), CHEM 1036. (3H,3C)

### 3514: PLANT PHYSIOLOGY LAB

A laboratory course designed to illustrate basic physiological principles related to nutrient deficiencies, membrane permeability and composition, water/nutrient absorption and translocation, transpiration, photosynthesis, physiological functions of growth regulators, enzyme activity, and elemental composition of plant tissue. Course requirements may be satisfied by taking PPWS 3504 or CSES 4344 prior to or concurrent with this course. (3L,1C)

### 3754: WEEDS THAT SHAPE OUR WORLD

Introduction to weed management methods, weed characteristics- chemistry, morphology and reproduction, and the economic and social factors that both drive and limit efforts to control plant populations. Identification of weed species. Pre: (BIOL 1005 or BIOL 1105 or BIOL 1205H), (BIOL 1006 or BIOL 1106 or BIOL 1206H). (3H,3C)

### 4104: PLANT PATHOLOGY

Introduction to plant pathology as a science and a crop protection discipline. Plant disease diagnosis, biology, and identification of plant disease-causing agents, factors leading to disease build-up, and management of plant diseases. Diseases of specific crops are studied as examples to illustrate general principles. Pre: (BIOL 1005 or BIOL 1105), (BIOL 1006 or BIOL 1106). (3H,3L,4C)

### 4114: MICROBE FORENSICS/BIOSECURITY

Concepts of comparative and evolutionary genomics for pathogen characterization and identification



taught through case studies of bioterrorism, involuntary and voluntary disease transmission, infectious disease epidemics, and genetically modified organisms; emphasis placed on unambiguous source attribution of a disease outbreak to a particular microbe, risk assessment, response as individual, community, and nation to a bioterrorism attack or disease outbreak, federal biosecurity regulations, and career opportunities. Pre: BIOL 2604, (BIOL 2104 or BIOL 2004). (3H,3C)

#### 4264 (ENT 4264): PESTICIDE USAGE

An interdisciplinary study of pesticides used in urban and agricultural environments. Topics studied will include: classification, toxicology, formulation, application techniques, safety, legal considerations, environmental impact, and research and development of new pesticides. Pre: CHEM 2515 or CHEM 2536. (2H,3L,3C)

#### 4504: FUNDAMENTALS OF PLANT PHYSIOLOGY

Fundamental principles of plant physiology (photosynthesis, respiration, transpiration, nutrition, translocation, and development) will be integrated with discussion of the relationship between abiotic environmental factors and plant physiological processes. Both agricultural and non-crop plants will be emphasized. Pre: (BIOL 1006 or BIOL 2304), CHEM 1036. (3H,3C)

#### 4604: BIOLOGICAL INVASIONS

Broad overview of the causes, consequences, and epidemiology of invasive plants, animals, and microbes. Conceptual, mechanistic, societal, and political components of invasive species from Darwin to modern day, covering the invasion process from introduction to ecological or economic impact. Taxonomy, management, and risk assessment will be covered via case studies, within a policy context. Pre: BIOL 1105, BIOL 1106. (2H,3L,3C)

#### 4754: WEED SCIENCE: PRINCIPLES AND PRACTICES

Weeds and human affairs; costs and losses; emphasis on weed biology, weed identification and weed-crop ecology; agronomic, physiological, and chemical principles underlying prevention, eradication, and control of undesired vegetation; methods of weed control available for modern agronomic, forestry, horticultural, and non-crop situations. Pre: BIOL 2304, CHEM 1036. (2H,3L,3C)

#### 4964: FIELD STUDY

Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Political Science

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### Overview

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[Legal Studies Option for the B.A. Degree](#)

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**Chair:** Karen M. Hult

**University Distinguished Professor:** T. W. Luke

**Edward S. Diggs Professor in the Social Sciences:** E. Weisband

**Professors:** F. Debrix, K. M. Hult, I. A. Luciak, and C. L. Taylor

**Associate Professors:** C. Apodaca, B. Koch, D. J. Milly, W. D. Moore, S. G. Nelson, I. Stivachtis, and L. Zanotti

**Assistant Professors:** P. C. Avey, G. Blouin-Genest, R. C. Briggs, M. Caraccioli, P. Dixit, N. Goedert, R. Kalyan, J. P. Kelly, E. Jardine, C. Jewitt, L. P. Plotica, B. Pula, and A. J. Scerri

**Visiting Assistant Professors:** B. S. Faulkner and C. I. P. Thomas

**Instructors:** J. A. Hanratty

**Emeritus Faculty:** R.C. Rich, R.D. Shingles, and C.E. Walcott

**Internship Director:** C. I. P. Thomas (231-2855)

Web: [www.psci.vt.edu](http://www.psci.vt.edu)

## Overview

The department offers courses leading to degrees in Political Science and International Studies. These courses provide understanding of political systems, forms of government, international relations and other political processes throughout the world. Political science courses also offer preparation for careers in government, business, law, politics, and education.

## General Option for the B.A. Degree

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Legal Studies Option for the B.A. Degree

This option is intended to help students gain appreciation of one of western civilization's greatest intellectual achievements: the structure and application of the law. The option is not intended to be a pre-law program, although students hoping to attend law school may enroll for the option and may well benefit from its completion.

## National Security Option for the B.A. Degree

This option is intended to help students understand policy making in relation to the national security of the United States. Students are directed toward courses in foreign and military policy and the presidential and congressional branches of government.

## Political Thought Option for the B. A. Degree

This option directs attention to courses in the department that focus upon political thought and to courses in other university departments that deal with ethical thought. This interdisciplinary approach is designed to enable students to contextualize their study of political theory and ethics in a broad scholarly framework.

## Minors

The requirements to earn a minor in Political Science or National Security and Foreign Affairs can be found on the specific checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

Students majoring or minoring in Political Science or International Studies may not complete the National

Security and Foreign Affairs minor.

## Regarding Double Majors

The Department of Political Science offers majors in both Political Science and International Studies. Courses for the two majors overlap significantly. Therefore, students may not pursue both majors simultaneously, nor major in one and minor in the other.

## Advising

The department provides advisors to help students understand and meet degree requirements. Career counseling also is available in the department, as is advising for students interested in attending law school after graduation from Virginia Tech.

## Internships

The department arranges academic credit for internships in state, local, and federal governments, nonprofit organizations, and other appropriate settings. The department's internship program offers students a chance to gain career-related experience in a wide variety of organizations. Information on these opportunities can be obtained from the internship director.

## Student Organizations

To provide opportunities for informal association of faculty and students, the department sponsors the Political Science Club, a chapter of Phi Alpha Delta, the pre-law honor fraternity, a chapter of Pi Sigma Alpha, the national honor society in political science, and other student organizations. Information about these activities, as well as about any other aspect of the department, may be obtained from the department chair, advisors, or the department office.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the Curriculum for Liberal Education (see Academics chapter in this catalog), toward the department's general education requirements, and toward the degree in Political Science.

Satisfactory progress toward the B.A. in political science requires completion of PSCI 1014, 1024, and 2024 within the first 60 credit hours attempted. Students must also maintain an in-major GPA of 2.0 and must achieve a minimum grade of C in both PSCI 1014 and 1024.

## Study Abroad

Virginia Tech offers a variety of study abroad programs.

## Honors

Honors courses are offered in Political Science. Majors in the department also may be admitted into the University Honors Program. In this program, they may choose among a variety of honors diplomas. Several of these require a senior honors thesis written under the direction of a faculty member in the department.

## Undergraduate Course Descriptions (PSCI)

1004 (IS 1004): NATIONS AND NATIONALITIES

Introduction to world and American ethnic and indigenous cultures and to social constructions of human and group identity, nationalism and extreme ethno-nationalism. Music, dance, film, art, ceremonial rituals and other multimedia forms of creative or symbolic expression, supplement readings and lectures. Multidisciplinary exploration of collective conceptions of cultural differences. (3H,3C)

**1014: INTRODUCTION TO UNITED STATES GOVERNMENT AND POLITICS**

Government and politics of the United States; the Constitution, political culture, interest groups, political parties, elections, Congress, bureaucracy, presidency, and federal courts; selected current policy issues. (3H,3C)

**1014H: HONORS INTRODUCTION TO UNITED STATES GOVERNMENT AND POLITICS**  
(3H,3C)

**1024: INTRODUCTION TO COMPARATIVE GOVERNMENT AND POLITICS**

Government and politics of selected countries outside the United States; nature of politics and government, types of political systems, linkages of people and governments, and current political issues. (3H,3C)

**1024H: HONORS INTRODUCTION TO COMPARATIVE GOVERNMENT AND POLITICS**  
(3H,3C)

**1034 (IS 1034): INTRODUCTION TO INTERNATIONAL STUDIES AND POLITICAL SCIENCE**

Introduces students to the fields of International Studies and Political Science and their respective subfields. Familiarizes students with the undergraduate programs in International Studies and Political Science and emphasizes student preparation for careers in the respective fields. Focuses on inquiry, problem-solving, and integration of ideas and experiences with a focus on International Studies and Political Science. Familiarizes students with the basic principles of the research and writing principles. (3H,3C)

**2014: INTRODUCTION TO POLITICAL THEORY**

Examines central themes involved in the practices of normative political theory. Topics will include critical review of the historical origins, established traditions, and major themes in normative political thinking. (3H,3C)

**2024: RESEARCH METHODS IN POLITICAL SCIENCE**

Introduction to research in political science; formulation of theory, operationalization and measurement, gathering, analysis and interpretation of data. Pre: 1014 or 1014H, 1024 or 1024H. (3H,3C)

**2034 (GEOG 2034) (IS 2034): GEOGRAPHY OF GLOBAL CONFLICT**

Geographical dimensions of global conflicts, international management of conflicts, conflicts of differences, historical, ideological, failed states and resources will be examined. Background to conflicts, current status of conflicts, different points of view in conflict. Topics in the course will change as the geography of global conflict changes. (3H,3C)

**2044 (FST 2044) (IS 2044): FOOD, WAR AND CONFLICT**

Explores the history of food production and processing relative to the commencement or continuation of conflict. Examines why and how wars have been fought over economic policies, food trade and control of food supplies. Examines efforts to protect food and water supplies from intentional contamination and acts of terrorism. Focus on food products and their preservation, processing and distribution technologies that arose from war and conflict. (3H,3C)

**2054 (GEOG 2054) (IS 2054): INTRODUCTION TO WORLD POLITICS**

An introduction to the prevalent methods and theories in the study of world politics. Topics include: historical context of contemporary world politics, global actors and power relations, international conflict and conflict resolution, international systems, interdependence, trade and integration, international law and prospects for global governance. (3H,3C)

**2064 (GEOG 2064) (IS 2064): THE GLOBAL ECONOMY AND WORLD POLITICS**

An introduction to the interaction of politics and economics, power and wealth, within the world political

economy. Topics include: the international financial system, the dynamics and principles of trade, and the role of transnational firms, as well as issues of environmental protection, sustainable development, and the distribution of wealth and power. (3H,3C)

#### 2074: LAW AND POLITICS

Explores the roles of law and legal institutions within the United States. Focuses on structures and procedures of government from a constitutional perspective; the politics of law-making and law-enforcement by legislative, executive, and judicial institutions; and relationships between law and society. Pre: 1014 or 1014H. (3H,3C)

#### 2084 (IS 2084): THEORETICAL APPROACHES TO GLOBAL ORDER

Examines the evolution of the inter-state system and focuses on the political, economic, societal and technological processes that shape the relations among states and people. Investigates topics such as the role of religion, culture and civilizations in world affairs; the globalization of the European system and the question of human equality; the impact of colonialism and post-colonialism on the question of justice and rights; and the effects of imperialism, capitalism and globalization on world order. (3H,3C)

#### 2134 (GEOG 2134) (IS 2134): GEOG OF THE GLOBAL ECONOMY

Geographical dimensions of the global economy since World War II. Globalization and the emergence of a new international division of labor. The relative decline of the United States and the growth of Japan, East Asia and the European Union. Changing geographies of foreign direct investment location. Places and regions in geo-economic discourse. Population and resources issues in the early twenty-first century. (3H,3C)

#### 2894 (ECON 2894) (PHIL 2894): INTRODUCTION PHILOSOPHY, POLITICS, AND ECONOMICS

Integrated study of philosophy, politics, and economics. Trains students to make decisions that are not only economically sound, but also socially, ethically, and politically informed. Topics included: models of human nature, rational choice theory, social cooperation, distributive justice, markets, and democracy. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course. 3004 (IS 3004): PROFESSIONALISM AND CAREERS IN POLITICAL SCIENCE AND INTERNATIONAL STUDIES

Designed to teach students how to synthesize skills and information learned in their Political Science and International Studies classes. Exploration of various career options, graduate school options, and proper procedures for seeking and applying for employment and graduate school. Introduction to professionalism in the workplace and professional development in the area of political science and international studies. Junior Standing. (3H,3C)

#### 3015,3016 (PHIL 3015, 3016): POLITICAL THEORY

Analysis of the fundamental ideas in the history of political theory. 3015: Plato to the 17th century. 3016: late 17th century to the present. Pre: 2014. (3H,3C)

#### 3034 (GEOG 3034) (IS 3034): THE CIA: ITS CAPABILITIES IN TODAY'S GEO-POLITICAL WORLD

Role of the discipline of geography in the origins, procedures, and history of CIA. Role of the CIA in providing national intelligence at both strategic and operational levels. Origins and changes to the CIA since WWII. Capabilities to support both policy-makers and national security entities. Case studies illustrating the CIA's operations in different regions of the world. (3H,3C)

#### 3104 (IS 3104): SECURITY STUDIES: THEORIES AND CONCEPTS

Introduces the various theoretical approaches to security. Examines key concepts in the field of Security Studies, such as uncertainty, polarity, war, coercion, terrorism, intelligence, genocide, crimes against humanity, ethnic conflict, and human security. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3114 (IS 3114): GLOBAL SECURITY

Explores various theoretical approaches to security and discusses traditional and non-traditional security issues. Focuses on global, international and regional security challenges and examines alternative strategic and tactical solutions for addressing them. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3115,3116 (IS 3115, 3116): SELECTED WORLD PROBLEMS

Selected world problems and how they affect various countries. Each semester, a topic will be chosen. (3H,3C)

#### 3125-3126 (IS 3125-3126): INTELLIGENCE AND NATIONAL SECURITY

Introduces students to the field of Intelligence Studies. Focuses on the structure, role and capabilities for the U.S. intelligence community and investigates the relationship between intelligence and national security strategy. Addresses topics pertaining to data collection and intelligence analysis, covert operations and counterintelligence. 3125: Intelligence and National Security. 3126: The Intelligence Process. Pre: IS 2054 or PSCI 2054 or GEOG 2054 for 3125; IS 3125 or PSCI 3125 for 3126. (3H,3C)

#### 3134 (IS 3134): GLOBAL CONFLICT AND WAR

Focuses on the causes, legal and moral constraints, impacts, and consequences of conflict and war. Explores historical and contemporary cases of conflict and war and investigates the role of state and non-state actors in these conflicts. Examines the impact of technology, religion, culture and identity on the present and future of war. (3H,3C)

#### 3135-3136 (IS 3135-3136): STRATEGIES FOR MODERN WARFARE

3135: Analyzes the theory and practice of conventional warfare and investigates how strategic thought has influenced and shaped modern warfare. 3136: Examines the theory and practice of irregular warfare and focuses on the theory and practice of counterinsurgency and counterterrorism. Pre: IS 2054 or PSCI 2054 or GEOG 2054 for 3135; IS 3135 or PSCI 3135 for 3136. (3H,3C)

#### 3144 (IS 3144): GLOBAL GOVERNANCE & PUBLIC POLICY

Examines the norms, institutions, practices and processes developed by the international community to address global problems such as poverty, pandemics, global warming, displaced persons and transnational crime. Utilizes theories of decision- and policy-making and investigates the role of states, international governmental and non-governmental organizations, coalitions and corporations in global public policy-making. Pre: (IS 2054 or PSCI 2054 or GEOG 2054), (IS 2064 or PSCI 2064 or GEOG 2064). (3H,3C)

#### 3154 (IS 3154): TOPICS IN GLOBAL PUBLIC POLICIES

Examines in depth selected global public policies pertaining to health, energy, development, education, refugees or labor. May be repeated with different content for a maximum of nine (9) credits. Pre: (IS 2054 or PSCI 2054 or GEOG 2054), (IS 2064 or PSCI 2064 or GEOG 2064). (3H,3C)

#### 3165,3166 (IS 3165, 3166): GLOBAL ECONOMIC GOVERNANCE & POLICY

3165: International Trade - Focuses on the operations of global and regional international organizations such as the World Trade Organization (WTO), the European Union (EU), the United Nations Conference on Trade and Development (UNCTAD), the United Nations Industrial Organization (UNIDO) and the World Intellectual Property Organization (WIPO) and examines their policies and regulations. 3166: International Finance- Focuses on the operations of global and regional international organizations such as the International Monetary Fund (IMF) and World Bank, the European Union (EU), the Organization for Economic Cooperation and Development (OECD) and examines their policies and regulations. Pre: IS 2064 or PSCI 2064 or GEOG 2064. (3H,3C)

#### 3175,3176 (IS 3175, 3176): GLOBAL DEVELOPMENT

3175: The Politics of Development - Examines issues and politics of the developing world and

investigates the forces that promote or cut off economic development in low-income countries. Discusses development issues in various world regions. 3176: Economic Development - Emphasizes economic development and focuses on domestic and international policies aiming at addressing poverty in the developing world. Pre: (IS 2054 or PSCI 2054 or GEOG 2054), (IS 2064 or PSCI 2064 or GEOG 2064). (3H,3C)

#### 3184 (IS 3184): HUMAN SECURITY

Introduces the field of human security and examines the conceptual, theoretical and methodological issues surrounding it. Identifies the relevant human security actors, explores the tools of human security, and discusses the application of human security. Investigates the implications of human security and discusses its future. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3194 (IS 3194): NUCLEAR STRATEGY & POLITICS

Examines the fundamentals of nuclear strategy and investigates the politics associated with the acquisition and proliferation of nuclear weapons. Focuses on nuclear doctrines and policies and explores international efforts associated with nuclear arms control and disarmament. Analyzes the nuclear postures of various nuclear states. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3214: POLITICAL PARTICIPATION

Levels and types of political participation; reasons for participation; who participates and why; effects of political activity on political processes. Pre: 1014 or 1014H or 1024 or 1024H. (3H,3C)

#### 3224: PUBLIC OPINION

Sources and distribution of public opinion; measurement of public opinion; relationships between public opinion and public policy; institutions linking public opinion to government decisions. Pre: 1014 or 1014H or 1024 or 1024H. (3H,3C)

#### 3234: VOTING AND ELECTIONS

Voting, elections, and support for political parties and party leaders in the United States and other Western democracies; impact of economic conditions on political support and patterns of realignment and dealignment. Pre: 1014 or 1014H or 1024 or 1024H. (3H,3C)

#### 3244 (COMM 3244): POLITICAL COMMUNICATION

Distribution of political information; elite-mass communication; alternative models of political communication; communication and telecommunications policy. Pre: 1014 or 1014H or 1024 or 1024H. (3H,3C)

#### 3254 (COMM 3254): MEDIA AND POLITICS

Explore the role of the mass media in contemporary American politics by examining the development of media as sources of social and political influence. Study of news organizations, their coverage of electoral and issue campaigns, and their impact on candidates and voters. Includes the role of new technologies in campaigns. Pre: Junior Standing. (3H,3C)

#### 3255,3256: THE POLITICS OF RACE, ETHNICITY AND GENDER

Studies the status and political behavior of selected political minorities. 3255: compares African-, Mexican- and Native-Americans. 3256: examines diverse political responses to traditional gender roles, current gender issues, and the unique gender problems facing people of color. Pre: 1014 or 1024. (3H,3C)

#### 3264: INTEREST GROUPS

Formation, structure, activities, and regulation of interest groups; comparison of American interest groups with those in other countries; evaluation of interest groups as participants in the political process. Pre: 1014 or 1014H or 1024 or 1024H. (3H,3C)

#### 3274: POLITICAL PARTIES

Development, organization, activities, and personnel of political parties; citizens' partisan attitudes and behavior; origins, characteristics, stability, and changes of party systems. Pre: 1014 or 1014H or 1024 or 1024H. (3H,3C)



### 3314: CONGRESS

Congressional structure; organization and procedure; characteristics of members of Congress; Congressional elections; decision-making and external influences; change and reform. Pre: 1014 or 1014H. (3H,3C)

### 3324: THE PRESIDENCY

Election, institutionalization, staffing, relations with Congress, and the bureaucracy; initiation and implementation of public policy. Pre: 1014 or 1014H. (3H,3C)

### 3334: JUDICIAL PROCESS

Structure and functions of American legal institutions; participants in the process, impact of legal institutions on society. Pre: 1014 or 1014H. (3H,3C)

### 3344 (UAP 3344): GLOBAL ENVIRONMENTAL ISSUES: INTERDISCIPLINARY PERSPECTIVES

Critical examination of major global environmental problems (e.g., global warming, atmospheric ozone depletion, acid rain, tropical deforestation, toxic waste) with emphasis on their social, economic, political, ethical, and policy implications and solutions. Pre: Completion of Area 4 of University Core. (3H,3C)

### 3354: CONSTITUTIONAL LAW: STRUCTURES AND RELATIONSHIPS

Power and authority of president, Congress, and courts; division of powers between states and federal government. Pre: 1014 or 1014H. (3H,3C)

### 3364: CONSTITUTIONAL LAW: CIVIL AND POLITICAL RIGHTS

Civil rights and liberties; rights of criminal defendants; competing conceptions of constitutional rights. Pre: 1014 or 1014H. (3H,3C)

### 3414 (UAP 3434): PUBLIC ADMINISTRATION

The role and context of public administration in the contemporary United States, administrative organization and decision-making, public finance, human resources administration, and program implementation. Pre: 1014 or 1014H. (3H,3C)

### 3424: STATE AND LOCAL GOVERNMENT

Institutions, functions, and policies of state, county, and municipal governments in the U.S.; issues confronting these governments in the federal system. Pre: 1014 or 1014H. (3H,3C)

### 3434: URBAN POLITICS

Basic concepts of urban politics; governmental structures, policy processes, and political conflicts in U.S. cities, policy options for coping with urban problems. Pre: 1014 or 1014H. (3H,3C)

### 3444 (UAP 3444): ADMINISTRATIVE LAW AND POLICY

The legal context of the exercise of discretion by public administrators in the United States. Adjudication and rule-making; access to administrative processes and information; legislative and judicial control of administration. Pre: 1014 or 1014H. (3H,3C)

### 3514: LATIN AMERICAN GOVERNMENT AND POLITICS

Introduction to the political systems of Latin American countries, including legislative-executive relations, interest groups, political parties, electoral systems, political violence, and socio-political development. Pre: 1014H or 1024. (3H,3C)

### 3515,3516: EUROPEAN POLITICAL SYSTEMS

The government and politics of selected European states and of the European Union. 3515: normally includes the United Kingdom. 3516: normally includes Germany and Hungary. Pre: 1024 or 1024H. (3H,3C)

### 3524: POLITICS OF POST-COMMUNIST SYSTEMS

Institutions, party structures, political economy, elite politics, ethnic conflicts, leadership dynamics, and mass political behavior in Russia and other post-communist political systems. Pre: 1024 or 1024H. (3H,3C)

#### 3534: AFRICAN GOVERNMENT AND POLITICS

Survey of major concepts and themes in the study of African politics and development: analyses of the state, political institutions, social forces, democratization, sustainable development, issues of contemporary African politics. Pre: 1024 or 1024H. (3H,3C)

#### 3544 (JUD 3544) (RLCL 3544): THE STATE OF ISRAEL: A POLITICAL HISTORY

This course provides a survey on the political history of the State of Israel and highlights major themes uniquely characterizing the specific events surrounding its establishment and its first 50 years of existence. Additionally, the course will add a comparative dimension by using the political history of Israel as a case study to discuss major themes in political science such as democracy, government, political economy, etc. Pre: 1024 or 1024H or JUD 2134. (3H,3C)

#### 3554: COMPARATIVE POLITICAL ECONOMY

Economic policies and collective choice processes of pre-industrial, industrializing, and advanced industrial states; problems and crises of industrial development, economic distribution, and technological transfer in the transition from an agrarian to advanced industrial society. Pre: 1024 or 1024H. (3H,3C)

#### 3564: VIOLENT POLITICAL CHANGE

Historical origins, political processes, and institutional outcomes of violent political change, rising from mass protest movements, revolutionary organization, military coups, and radical political parties. Pre: 1024 or 1024H. (3H,3C)

#### 3574: GOVERNMENT AND POLITICS OF JAPAN

Introduction to governmental institutions, patterns of political organization and behavior, and key policies of the Japanese political system. Pre: 1024 or 1024H. (3H,3C)

#### 3584: GOVERNMENTS AND POLITICS OF ASIA

Introduction to governmental institutions, political behavior, and social and economic policy approaches of China and other selected countries in the Asian region. Pre: 1024 or 1024H. (3H,3C)

#### 3615-3616 (IS 3615-3616): INTERNATIONAL RELATIONS

Structure and development of the modern international system; theories of international politics; international law; international organizations. Pre: IS 2054 or PSCI 2054 or GEOG 2054 or PSCI 2064 or IS 2064 or GEOG 2064 for 3615; 2054 or IS 2054 or GEOG 2054 or PSCI 2064 or IS 2064 or GEOG 2064 for 3616. (3H,3C)

#### 3624 (IS 3624): FOREIGN POLICY AND DIPLOMACY

Focuses on actors, issues, and processes pertaining to foreign policy formulation and implementation. Examines theoretical and historical perspectives on foreign policy analysis. Investigates the national security, foreign policy, and diplomacy nexus. Discusses types of diplomacy and diplomatic methods. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3625,3626 (IS 3625, 3626): US-RUSSIA FOREIGN POLICIES

3625: Formulation of American foreign policy; roles of the President, Congress, press, public, and bureaucracy; central themes, issues, and problems of American diplomacy; 3626: Development and operational practices of Russian foreign policy decision-making in the international environment; party and state political institutions; Marxist-Leninist ideology. Pre: 1024 or 1024H. (3H,3C)

#### 3634 (IS 3634): HUMAN RIGHTS: GLOBAL ISSUES

Identification, articulation and clarification of the relationship between human rights and other contemporary international phenomena, issues, events, and processes that affect human rights. Detailed consideration of the diverse traditions and cultural interpretations of human rights. Pre: 1024 or 2054 or IS 2054 or GEOG 2054. (3H,3C)

#### 3684 (AINS 3684): INDIGENOUS PEOPLES AND WORLD POLITICS

A survey of the historical and contemporary struggles of indigenous peoples throughout the world. Examines the dynamics of colonialism (internal and external), identity construction, gender, cultural integrity, and the ongoing global indigenous rights discourse. In addition to covering broad global processes/theoretical approaches, comparative case studies of particular indigenous groups, such as the

Maasai (Kenya, Tanzania) and Mayans (Mexico, Guatemala, Belize), are used to highlight the global, regional and intra-community diversity among contemporary indigenous peoples. (3H,3C)

#### 3704 (IS 3704): NATIONAL SECURITY STRATEGY

Focuses on the causes of war and the conditions of peace. Examines the logic, levels, and outcomes of strategy and investigates the impact of international law and politics on the use of force. Explores contemporary strategic theory and discusses current issues in grand strategy. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3714 (UAP 3714): THE U. S. POLICY PROCESS

Description and analysis of the processes and institutions involved in the making and implementation of public policy in the United States, with a primary focus on domestic and economic policy. Empirical and normative models of the process of public policy making in the U.S. Pre: 1014 or 1014H. (3H,3C)

#### 3724: POVERTY AND WELFARE POLICY

Public policies regarding the poor, impact of current policies; future policy options. Pre: 1014 or 1014H. (3H,3C)

#### 3734 (IS 3734): NATIONAL SECURITY

Post-1945 strategic problems, policies, and security commitments of major participants in international politics, especially the United States and Russia; effects of security policies on international and domestic political economies. Pre: 2054 or IS 2054 or GEOG 2054. (3H,3C)

#### 3735-3736 (IS 3735-3736): NATIONAL SECURITY POLICIES

Investigates the purposes, contexts and processes of national security policymaking both in the United States and in other states around the world. 3735: Focuses on Homeland Security. 3736: Focuses on Defense Policy. Pre: IS 2054 or PSCI 2054 or GEOG 2054 for 3735; IS 3735 or PSCI 3735 for 3736. (3H,3C)

#### 3744 (UAP 3744): PUBLIC POLICY ANALYSIS

Methods and approaches used in the analysis and evaluation of public policy; strengths and limitations of various analytic tools; normative issues in the practice of policy analysis. Pre: 1014 or 1014H. (3H,3C)

#### 3754: AMERICAN POLITICAL THEORY

American political theory from the pre-Revolutionary era to the present. American contribution to the understanding of freedom, equality, political community, constitutionalism, political dissent, and the welfare state. Pre: 1014 or 1014H. (3H,3C)

#### 3764: CONTEMPORARY DEMOCRATIC THEORY

History and critiques of classical theories of democracy; contradictions within and contemporary problems facing democracy; future of democracy according to conservative, liberal, and radical theoretical perspectives. Pre: 2014, (3015 or 3016). (3H,3C)

#### 3774 (UAP 3774): MARXIAN POLITICAL ANALYSIS

Contemporary uses of Marxian concepts and theories to study the world economy, business structure, current social issues, modern ethical values, and alienation. Pre: 2014, (3016 or 3554). (3H,3C)

#### 3784: ORIGINS OF THE STATE

Theories of the origins of politics and government; evidence of state formation in prehistoric societies; political behavior in contemporary pre-literate societies as precursor to state formation. Pre: 2014, (3015 or 3016). (3H,3C)

#### 3794 (IS 3794): TERRORISM AND COUNTERTERRORISM

Examines approaches to the categorizations and causes of terrorism and discusses national and regional understanding of terrorism. Explores official and popular understandings of terrorism over time and across regions and investigates how social actors legitimate their use of violence. Focuses on the development of useful counterterrorism policies and utilizes case studies in terrorism and counterterrorism to emphasize the link between theory and practice. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4024 (IS 4024): SEMINAR IN DIPLOMACY AND SECURITY

In-depth analysis of selected topics in diplomacy, strategy, and national security including issues pertaining to international conflict and cooperation; dimensions of national power; objectives of national policy and implementation of national strategy; diplomatic negotiations; and conflict resolution. Senior Standing. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

#### 4054 (IS 4054): SEMINAR IN GLOBAL POLITICAL ECONOMY

Examines theoretical and historical approaches to global political economy and assesses their practical implications. Focuses on issue areas such as production, trade, money, finance and investment and analyzes their implications for the global economic and political order. Investigates issues pertaining to economies of development and in transition. Senior Standing. Pre: IS 2064 or PSCI 2064 or GEOG 2064. (3H,3C)

#### 4064 (IS 4064): SEMINAR IN GLOBAL DEVELOPMENT

Examines how economic and political forces interact in the developing world, discusses the history of these interactions from the pre-colonial period to the present and explores how colonialism shaped the developing world's economic and political trajectories. Utilizes case studies, historical analysis and development economies to better understand the economic and political condition of countries in the developing world. Senior Standing. (3H,3C)

#### 4214: SENIOR SEMINAR IN POLITICAL BEHAVIOR

Political behavior: socialization, voting, opinion formation and expression, decision-making in government, as explained by personality, rationality, culture, class, and institutional roles. Topics vary from semester to semester as announced. Must have senior standing. Pre: 3214 or 3224 or 3234 or 3244 or 3264 or 3274. (3H,3C)

#### 4314: SENIOR SEMINAR IN POLITICAL INSTITUTIONS

Selected topics in political institutions, including decision-making, types and structures of political institutions, internal and external influences on institutional behavior. Topics vary from semester to semester. Must have senior standing. X-grade allowed. Pre: 3314 or 3324 or 3334 or 3515 or 3516 or 3524. (3H,3C)

#### 4324: SENIOR SEMINAR IN CONSTITUTIONAL LAW

Cases, law review articles, and related materials containing describing, or commenting on major decisions of the U.S. Supreme Court. Topics vary from semester to semester as announced. Must have senior standing. Pre: 3354 or 3364. (3H,3C)

#### 4414: SENIOR SEMINAR IN PUBLIC ADMINISTRATION

Selected topics in public administration, including norms of practice, government personnel, administrative process, administrative law, privatizing, and contracting. Topics vary from semester to semester as announced. Must have senior standing. Pre: 3414 or 3424 or 3444. (3H,3C)

#### 4514: SENIOR SEMINAR IN COMPARATIVE POLITICS

Selected topics in the comparative analysis of political behavior, processes, and institutions; cross-national institutional and aggregate data analysis. Topics vary from semester to semester as announced. Must have senior standing. Pre: 3515 or 3516 or 3524 or 3554 or 3564 or 3514 or 3534 or 3544 or 3574 or 3584. (3H,3C)

#### 4614 (IS 4614): SENIOR SEMINAR IN INTERNATIONAL RELATIONS

Selected topics in international relations, including objectives of national policy, dimensions and components of national power, comparative diplomacy, international conflict and cooperation, instruments for conflict resolution. Topics vary from semester to semester as announced. Must have senior standing and any two of the prerequisites. Pre: 3615 or 3616 or 3625 or 3626 or 3734. (3H,3C)

#### 4624 (UAP 4624): THE WASHINGTON SEMESTER: SEMINAR IN AMERICAN POLITICS AND PUBLIC POLICY

This seminar is the integrative forum for the principal elements of the Washington Semester experience. The course explores both the role of political institutions in policy formation and implementation and the primary managerial and leadership challenges that arise for implementing organization managers in American democratic public policy-making. Pre: Junior standing or instructor consent and acceptance into the Washington Semester program. X-grade allowed. (3H,3C)

**4644 (UAP 4644): THE WASHINGTON SEMESTER: POLITICS, POLICY AND ADMINISTRATION IN A DEMOCRACY**

This course is part of the Washington Semester. Explores the relationship between the imperatives of democratic mobilization, policy choices and organizational choices through intensive study of the operating context of a selected public or nonprofit organization. Examines implications of policy-maker choices for implementing institution dynamics and challenges. Pre: Junior standing and acceptance into the Washington Semester program required. X-grade allowed. Pre: 3714. (3H,3C)

**4714 (IS 4714): SENIOR SEMINAR IN POLICY ANALYSIS**

Theoretical, analytical, and methodological approaches used to assess government activities and public policy. Topics vary from semester to semester as announced. Must have senior standing. Pre: 3724, 3734. (3H,3C)

**4724: SENIOR SEMINAR IN POLITICAL THEORY**

Selected topics in analytic political philosophy, contemporary ideologies, and democratic theory. Topics vary from semester to semester as announced. Senior standing required. Must have senior standing and any two of the prerequisites. Pre: 3015 or 3016 or 3764 or 3754 or 3774. (3H,3C)

**4734 (IS 4734): THEORIES AND PRACTICES OF INTERNATIONAL CONFLICT MANAGEMENT**

Examines alternative perspectives on peace, security, and international intervention and their implications for policy. Focuses on the role international organizations and other actors in conflict resolution and peace-building and explores issues pertaining to humanitarian intervention, human security, and state-building. Utilizes case studies in peacekeeping and peace building to highlight the link between theory and practice. Pre: 3616. (3H,3C)

**4735,4736 (IS 4735, 4736): MULTILATERAL DIPLOMACY WORKSHOP**

Investigates the purpose, context, and process of multilateral diplomacy and focuses on the strategies and tactics associated with it. Examines format and products of multilateral conferences, decision-making process, negotiations, mediation, delegation management, and conference management. Utilizes case studies and simulations. 4735: focuses on multilateral diplomacy at the United Nations. 4736: focuses on multilateral diplomacy in the framework of regional international organizations. Pre: IS 2054 or PSCI 2054 or GEOG 2054 for 4735; 4735 for 4736. (3H,3C)

**4744 (IS 4744): INTELLIGENCE ANALYSIS WORKSHOP**

Examines the impact of historical experience and bureaucratic structures on intelligence analysis. Discusses the contents of the intelligence agenda and explores issues pertaining to intelligence analysis. Focuses on the intelligence process and offers a target-centric approach to intelligence analysis. Emphasizes and evaluates the use of structured analytic techniques in intelligence analysis. Pre: IS 2054 or PSCI 2054 or GEOG 2054. (3H,3C)

**4754: INTERNSHIP PROGRAM**

Qualified students are placed in an administrative or legislative staff position under the combined supervision of a faculty member and a responsible supervisor in the employing agency. Detailed reports on the internship experience and a specific project will be required of each intern. (Variable credit to maximum of 6 credits for a full-time position over an entire semester). Three hours of appropriate advanced American government courses, Junior standing, a screening interview, GPA of 3.00 or better and consent required. Variable credit course. X-grade allowed.

**4884 (ECON 4884) (PHIL 4884): ADVANCED TOPICS IN PHILOSOPHY, POLITICS, AND ECONOMICS**

Advanced topics at the intersection of philosophy, politics, and economics. Core methods and concepts: utility theory, game theory, social choice theory, public choice theory, markets, justice, and democracy. Senior research project. Pre: Senior standing. Pre: PHIL 2894 or PSCI 2894 or ECON 2894. (3H,3C)

4964: FIELD STUDY

Pass/Fail only. Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course. X-grade allowed.

4974H: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Psychology

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**Chair:** Robert S. Stephens

**University Distinguished Professor:** T. H. Ollendick

**Alumni Distinguished Professor:** E. S. Geller

**Heilig-Meyers Professor:** R. A. Winett

**Professors:** M. A. Bell, W. K. Bickel, G. A. Clum, K. Deater-Deckard, J. W. Finney, and R. T. Jones

**Associate Professors:** D. K. Axsom, J. C. Dunsmore, R. J. Foti, B. H. Friedman, J. Germana, D. W. Harrison, R. J. Harvey, N. M. A. Hauenstein, J. Kim-Spoon, R. K. Pannenton, and A. Scarpa

**Assistant Professors:** M. T. Braun, A. D. Cate, P. Chiu, R. A. Diana, B. King-Casas, J. A. Richey, and S. W. White

**Clinical Associate Professor:** L. D. Cooper

**Senior Instructor:** K. A. Hoffman

**Instructor:** P. K. Harrison

**Research Faculty:** M. Cowart, K. Cuevas, C. T. Ramey, S. L. Ramey, and B. White

**Affiliated Faculty:** D. L. Brinberg, K. Carlson, B. Klein, T. Smith-Jackson, and D. G. Tatar

**Adjunct Faculty:** A. B. Allen, W. D. Crews, and R. W. Greene

**Undergraduate Advising Coordinator:** Cindy Koziol (231-5388)

**Career Advisor:** Kurt Hoffman (231-4005)

Web: [www.psyc.vt.edu](http://www.psyc.vt.edu)

The Department of Psychology offers an undergraduate program leading to the B.S. To graduate with a major in psychology, the undergraduate student must complete the Curriculum for Liberal Education (CLE) requirements of the College of Science and the following departmental requirements:

A minimum of 28 hours of psychology including Psyc 2004, 2094, and three 4000-level courses, at least one with laboratory (Psyc 4964, 4974, and 4994 are not counted as 4000-level courses for purposes of this requirement).

Successful completion of at least one three-credit course from the Statistics Department, except Stat 3104. Stat 2004, 3604, or 3615 are recommended. (NOTE: No credit will be given for Stat 2004 if taken with or after any other statistics course.)

In addition to courses used to fulfill the Scientific Reasoning and Discovery requirement (Area 4) of the CLE, two courses (6 semester hours) in one of the following areas: biological sciences, chemistry, physics. These additional courses need not be in the same discipline as courses used to satisfy Area 4 of the CLE.

Successful completion of two courses (6 semester hours) from the disciplines of computer science, philosophy, and/or statistics. These courses may either be in the same discipline or from any two of the three disciplines. Courses used to satisfy CLE requirements or other Psychology department requirements may not also be used to satisfy this requirement.

To graduate with a minor in psychology, the undergraduate student must complete 18 hours of psychology including Psyc 2004, 2094, and one 4000-level course (Psyc 2964 and 4964 may not be used toward the psychology minor).

A program leading to the B.S. in psychology "in honors" is available for eligible students. Additionally, opportunities are provided for students to engage in a directed program of independent research. The department sponsors a chapter of Psi Chi, the national psychology honor society, and the Psychology Club. Information about these and other activities is available at the Academic Advising Center Office (109 Williams Hall) in the Department of Psychology.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Psychology can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (PSYC)



#### 1004: INTRODUCTORY PSYCHOLOGY

The scientific study of behavior, behavioral research methods and analysis and theoretical interpretations. Survey of basic behavioral processes from sensory and physiological mechanisms to personality types and complex decision-making in humans. Requires enrollment in 1 hour (0 credit) recitation. (3H,3C)

#### 1024: PATHWAYS THROUGH AND BEYOND THE PSYCHOLOGY MAJOR

First Year Experience course introducing students to the psychology major. Discussion of university resources designed to promote student success. Emphasis on career exploration, and finding relevant research and field experiences outside the classroom. (2H,2C)

#### 1094: PRINCIPLES OF PSYCHOLOGICAL RESEARCH

Philosophical foundation and ethical issues in psychological research. Research design and methodology. Analytic approaches to developing, understanding, interpreting psychological data. Pre: 1004 or 2004. (3H,3C)

#### 1524 (ENGL 1524): LANGUAGE AND THE MIND

Examination of what is unique about human language and the evidence that language affects thought. Investigation of how listeners categorize sounds, parse sentences, and access meaning. Examination of what brain damage and speech errors reveal about language in the brain and mind. (3H,3C)

#### 2034: DEVELOPMENTAL PSYCHOLOGY

Basic principles of human psychological development from the prenatal period through old age are examined. Surveys recent literature within the areas of perceptual, cognitive, and social/emotional development. Pre: 2004 or 1004. (3H,3C)

#### 2044: PSYCHOLOGY OF LEARNING

Survey of fundamental concepts, phenomena, and principles of learning, such as reinforcement, Pavlovian conditioning and retention/forgetting. Issues addressed are traditional views of learning, biological and cognitive constraints, the role of animal models, and the utility of learning theory. Pre: 2004 or 1004. (3H,3C)

#### 2054: PSYCHOLOGY OF PERSONALITY

Study of human personality and psychological adjustment: theory and research. Behavioral, cognitive, humanistic, and environmental determinants of personality. Psychological adjustment and personality development. Pre: 2004 or 1004. (3H,3C)

#### 2064: NERVOUS SYSTEMS & BEHAVIOR

Introduction to the workings of the nervous system and the relation between those workings and behavior. Special emphasis on human nervous systems and behavior. Pre: 2004 or 1004. (3H,3C)

#### 2074: ANIMAL BEHAVIOR

Study of animal behavior: Comparative psychology and ethology, behavioral genetics, evolution of behavior, ecological aspects of behavior, predation, reproduction, and parental care. Some consideration is given to the relevance of animal behavior to human behavior. Pre: 2004 or 1004. (3H,3C)

#### 2084: SOCIAL PSYCHOLOGY

Introduction to the social behavior of the individual and the group: social perception, attribution theory, attitude formation and change, interpersonal attraction, aggression and conflict, group dynamics, applied social psychology. Pre: 2004 or 1004. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course. X-grade allowed.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 2994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 3014: ABNORMAL PSYCHOLOGY

Survey of various types of psychological disorders and of contrasting theoretical views and representative research on the etiology and prognosis of these disorders. Emphasis on diagnosis and classification of disorders. Pre: 2004 or 1004. (3H,3C)

#### 3024: ENVIRONMENTAL PSYCHOLOGY

Survey of the effects of the environment on humans, and vice versa. Topics include crowding, noise, air, and water pollution and their effects on behavior. Research and theories about person-environment relations. Pre: 2004 or 1004. (3H,3C)

#### 3034: PSYCHOLOGICAL DISORDERS OF CHILDREN

An examination of theory, research, and practice as related to the assessment, treatment, and prevention of psychological disorders of children. Special emphasis on the understanding of child behavior disorders from a developmental, clinical-experimental point of view. Pre: (2004 or 1004), 3014. (3H,3C)

#### 3054: HEALTH PSYCHOLOGY

Major theories, strategies, and methods for understanding psychological contributions to health and disease; psychological approaches to the treatment and prevention of disease and unintentional injuries, and health and safety promotion. Pre: 2004 or 1004. (3H,3C)

#### 3094: ADVANCED RESEARCH METHODS IN PSYCHOLOGICAL SCIENCE

Advanced research and analytical methods. Emphasis on methods for specific research and/or practical questions, critical evaluation of research publications. Extended coverage of design and analysis principles and skills, selection and completion of appropriate statistical tests for given data sets. Student-driven empirical report including literature review, methods, analysis, interpretation, and implications for future research. PSYC majors only. Pre: 1094, (STAT 2004 or STAT 3604 or STAT 3615). (3H,3C)

#### 3154 (EDEP 3154): PSYCHOLOGICAL FOUNDATIONS OF EDUCATION

Emphasizes theories of human learning and the relationship of learning principles to educational practice. Within the context of both cognitive and behavioral models of learning, attention is given to instructional procedures, student motivation and discipline, and the assessment of educational progress. Pre: 2004 or 1004. (3H,3C)

#### 4014: HISTORY AND SYSTEMS IN PSYCHOLOGY

Overview of modern theories in psychology by consideration of current historical controversies. Traces roots of psychology in natural and social sciences. Considers the diversity of psychological study and the future of psychology. Senior standing in psychology required for undergraduate credit. Graduate standing required for graduate credit. (3H,3C)

#### 4024: INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY

Overview of psychological theories, research findings, and methods relevant to studying the behavior of individuals in organizations. Topics covered may include prediction of job performance, personnel testing, training and development, and leadership. Pre: (2004 or 1004), (STAT 2004 or BIT 2405 or STAT 3604 or STAT 3615). (3H,3C)

#### 4034: ADVANCED DEVELOPMENTAL PSYCHOLOGY

Development of attention, cognition, social skills, language, personality, and intelligence throughout the life-span: an in-depth, critical evaluation of current research and theory. Pre: (2004 or 1004), 2034. (3H,3C)

#### 4044: ADVANCED LEARNING

Critical analysis of basic paradigms of Pavlovian and Instrumental Conditioning with emphasis on general theories of learning and issues involved in cognition, reinforcement, and memory. Pre: (2004 or 1004),

2044, (2094 or 1094). (3H,3C)

#### 4054: PERSONALITY RESEARCH

Research techniques used in contemporary personality psychology: case histories, correlational methods, experimentation, archival studies, and psychobiography. Pre: (2004 or 1004), 2054, (STAT 2004 or STAT 3604 or BIT 2405). (3H,3C)

#### 4064: PHYSIOLOGICAL PSYCHOLOGY

Presentation of concepts important for the study of neuroscience and behavior with a special emphasis on the classic topics of physiological psychology: brain-behavior relations, sensory integration, physiological correlates of motivation and emotion. Pre: (2004 or 1004), 2064, (2094 or 1094). (3H,3C)

#### 4074: SENSATION AND PERCEPTION

Overview of sensory and perceptual systems and their integration in influencing behavior. Emphasis on sensory receptor characteristics, neural structure, psychophysical data, perceptual phenomena and issues, theories about the human perceptual process. Pre: (2004 or 1004), 2064, 2094. (3H,3C)

#### 4084: ADVANCED SOCIAL PSYCHOLOGY

Examines social behavior from four major theoretical orientations: reinforcement, field theory, cognitive, and role theory. Topics may include social learning, social exchange theories, group processes, attitude, and person perception. Pre: (2004 or 1004), 2084. (3H,3C)

#### 4094: THEORY OF PSYCHOLOGICAL MEASUREMENT

Theory of psychological measurement and techniques used to develop and evaluate psychological measures. Coverage of standardization, measurement scales, reliability, validity, score transformations, composite scores, weighted scores, and test construction. Pre: (2004 or 1004), 2094, (STAT 2004 or STAT 3604 or STAT 3615 or BIT 2405). (3H,3C)

#### 4114: COGNITIVE PSYCHOLOGY

An experimentally-oriented survey of human cognitive processes which include attention, memory, and decision making. Role of individual difference variables in each area. Pre: (2004 or 1004), 2044, (2094 or 1094). (3H,3C)

#### 4134 (ENGL 4134): LANGUAGE DEVELOPMENT

Survey of theories, mechanisms, and processes in human language development. Empirical overview of phonology, semantics, syntax, and pragmatics. Developmental trajectories of mono- and multilingual children. Cultural constraints on language. Perception of language and production of language, in typical and atypical subpopulations (e.g., hearing impairment). Junior/Senior Standing. Pre: 1004 or 2004. (3H,3C)

#### 4214: COGNITIVE PSYCHOLOGY LABORATORY

Design, operation, and analysis of experiments to study human cognitive processes (e.g., attention, memory, and decision-making). Co: 4114. (3L,1C)

#### 4234: LABORATORY IN DEVELOPMENTAL PSYCHOLOGY

Research design and implementation in the study of perceptual and motor development, language development, cognitive development, and social development. Pre: (2004 or 1004), 2034. Co: 4034. (3L,1C)

#### 4244: LABORATORY IN ADVANCED LEARNING

Experimental techniques for studying the development, maintenance, and retention of behavior change in humans and animals. Laboratory exercises in Pavlovian and Instrumental Conditioning, verbal learning and memory. Co: 4044. (3L,1C)

#### 4254: PERSONALITY RESEARCH LABORATORY

Laboratory course in personality research techniques. Emphasis on experimental, archival, questionnaire, and psychobiographical approaches. Co: 4054. (3L,1C)

#### 4264: LABORATORY IN PHYSIOLOGICAL PSYCHOLOGY

Experimental techniques in the area of physiological psychology including: handling and care of laboratory animals, anesthetic and surgical techniques, and measurement of physiological variables. Co: 4064. (3L,1C)

#### 4274: LABORATORY IN SENSATION AND PERCEPTION

Overview of the major experimental techniques and phenomena of sensation and perception. Emphasis on psychophysical methods, signal detection, dark adaptation, perceptual illusions. Co: 4074. (3L,1C)

#### 4284: LABORATORY IN SOCIAL PSYCHOLOGY

Design, performance, and analysis of experiments in social psychology. Various methodologies used in social research (e.g., laboratory experimentation, field observations) will be studied through actual performance of experiments. Co: 4084. (3L,1C)

#### 4294: LABORATORY IN PSYCHOLOGICAL MEASUREMENT

Design and implementation of psychological assessment devices including issues of test construction, reliability, validity, standardizing, and detecting test bias. Pre: (2004 or 1004), 2094, (STAT 2004 or STAT 3604 or STAT 2405). Co: 4094. (3L,1C)

#### 4354: SENIOR SEMINAR

For Psyc majors. Intended to provide in-depth coverage and discussion of a small set of topics selected by members of the seminar. Consent required. (3H,3C)

#### 4364: SENIOR SEMINAR

For Psyc majors. Intended to provide in-depth coverage and discussion of a small set of topics selected by members of the seminar. (3H,3C)

#### 4454 (ECON 4454) (NEUR 4454): NEUROECONOMICS

Neural processes related to reward, learning, reflection, delay of gratification, and social interaction. Clinical uses of neuroeconomics research techniques. Implications of neuroeconomics, policy, law and business. Pre: NEUR 2026 or ECON 3104. (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course. X-grade allowed.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Program in Real Estate

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[Plan of Study](#)

[Undergraduate Course Descriptions \(REAL\)](#)

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**Director:** Kevin J. Boyle

**Associate Director:** Rosemary Goss

**Manager of Academic Affairs and Business Operations:** Chelsea Lyles

**Principle Faculty:** Y. Beliveau - BC, V. Bonomo - FIN, R. Dymond - CEE, L. Geyer - AAEC, A. Keown - FIN, T. Koebel - UAP, R. Kumar - FIN, A. McCoy - BC, D. Read - AHRM, M. Sirgy - MKTG, K. Sullivan - FIN, E. Wiseman - FOR, and E. Zielenback - AHRM

Web: [www.realestate.vt.edu](http://www.realestate.vt.edu)

## Overview

The Program in Real Estate is a comprehensive, interdisciplinary academic program that draws classes from six colleges ([College of Agriculture and Life Sciences](#); [College of Architecture and Urban Studies](#); [Pamplin College of Business](#); [College of Engineering](#); [College of Liberal Arts and Human Sciences](#); and [College of Natural Resources and Environment](#)) to students with dynamic education. The Program is administratively housed in the [College of Architecture and Urban Studies](#).

The Program in Real Estate offers a Bachelor of Science degree in Real Estate. Real Estate courses integrate the material students learn in disciplinary courses such as finance, law, and property management through practical experiences within the academic program. The integration occurs through a university-industry partnership where real estate professionals are actively involved in students' education through guest lectures, mentoring experiences, and by providing internship opportunities.

In addition to learning about the broad field of real estate, students are encouraged to find their niche in the field. Students develop an area of expertise to fulfill their restricted electives requirement. This is accomplished by adding a second major, completing a minor, or creating an area of concentration (with the approval of their academic advisor) that meets each student's unique interests. Graduates of the Virginia Tech Program in Real Estate will be prepared to enter the Real Estate industry upon graduation and make immediate professional contributions.

## Plan of Study

Note: Graduation requires a total of 120 semester credit hours. Requirements are subject to change; prospective students should contact their academic advisor prior to initiating their programs of study.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Remarks

Restricted Electives - Students must have a restricted elective plan of study signed by their real estate advisor comprised of courses that form a focused area of study in the real estate profession. Students may substitute courses from a second major or a minor for restricted electives as long as the courses are not real estate requirements (listed above).

## Undergraduate Course Descriptions (REAL)

### 1004: DISCOVERING REAL ESTATE

First year experience for the Program in Real Estate. Academic planning, career exploration, and resources for academic success. Leadership, team building, communication and problem solving in the real estate industry. Role of ethics in the profession. Introduction to peer and professional mentors. (2H,2C)

### 2004 (UAP 2004): PRINCIPLES OF REAL ESTATE

Introduction to real estate, including markets, land use planning and zoning, development, finance, construction, sales, marketing, management and property valuation. Examines the key actors and processes in each of these areas. Explores major public policies impacting real estate (3H,3C)

### 2014: CAREERS IN REAL ESTATE

Provides an overview of multiple facets of the industry and specific skills needed to integrate knowledge from different disciplines. Examines potential careers and pathways to achieve professional success. Co: UAP 2004. (1H,1C)

### 2034 (BC 2034): REAL ESTATE DATA ANALYSIS

Real estate market data and the statistical tools for analyzing data to support decision making. Descriptive statistics and hypothesis testing. Form insights to inform management and investment decisions. Pre: UAP 2004 or REAL 2004. (2H,2C)

### 2984: SPECIAL STUDY

Variable credit course.

#### 3014: PROFESSIONAL DEVELOPMENT IN REAL ESTATE

Professional issues in the real estate industry such as interdisciplinary teamwork, ethics, and networking. Exposure to these topics through case studies, including presentations by real estate professionals. Pre: UAP 2004, REAL 2014. (1H,1C)

#### 3024: APPLIED REAL ESTATE DEVELOPMENT

Examines real estate development from design and construction through project management. Develops analysis tools based on feasibility studies, comprehensive plans and ordinances, and basic economic yield analyses. Applications carried out in lab exercises that include field visits and mock development scenarios. Pre: UAP 2004, REAL 2014. Co: 3014. (2H,2L,3C)

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4075-4076: REAL ESTATE STUDIO

Course provides mock, real-world learning in a student-led, team environment. Teams will analyze, design and develop a plan, for a mixed use or complex real estate development. Project spans two semesters. Students select a team project in consultation with faculty and industry advisors. Work will focus on all elements of preliminary design and approvals required to initiate a real-world development. For majors only. Pre: 3024 for 4075; 4075 for 4076. (1H,6L,3C)

#### 4964: FIELD STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Department of Religion and Culture

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### Overview

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[Undergraduate Course Descriptions \(RLCL\)](#)

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**Chair:** Brian Britt

**Professors:** B. Britt and M. Saffle

**Associate Professors:** A. Abeysekara, M. Gabriele, A. Puckett, E. Satterwhite, P. Schmitthenner, and R. Scott

**Assistant Professors:** A. Ansell, D. Christensen, and Z. Ni

**Instructors:** K. Dhillon, M. Goodrum, R. Kauffman, and M. Schnitzer

Web: <http://liberalarts.vt.edu/departments-and-schools/department-of-religion-and-culture.html>

## Overview

The Department of Religion and Culture critically investigates religion, culture, and their relationships by problematizing what is commonly considered self-evident, especially since these subjects are intrinsic to understanding the human condition both locally and globally. In our research, teaching, and engagement, we seek to craft and apply new forms of critical inquiry that advance integrative intellectual thought. These



paths of inquiry inform our engagement with students, who become well prepared to understand complex transformations throughout their lives, whether they pursue graduate studies or other life trajectories.

The department offers an undergraduate degree in Religion and Culture (RLCL) and minors in (alphabetically) American Studies, Appalachian Studies, Asian Area Studies, Judaic Studies, Medieval and Early Modern Studies, Middle East Studies, Popular Culture, and Religion.

The department also offers an M.A. in Material Culture and Public Humanities, two graduate certificates--one in Religious Studies and the other in Material Culture and Public Humanities; and participates in the Alliance for Social, Political, Ethical, and Cultural Thought (**ASPECT**) Ph.D. program.

## Religion and Culture Major (RLCL)

The Bachelor of Arts degree in Religion and Culture (RLCL) combines the strengths of the Department of Religion and Culture in the humanities and the study of religion in order to provide students with opportunities to examine several of the twenty-first century's most important global phenomena. Students completing this cutting-edge degree will explore the impact of religion and religious practices on politics, economics, the arts, and everyday life, as well as the impact of cultural shifts in moral and ethical practices, the arts, the dissemination of information and entertainment, and the influence of traditional values and attitudes within our emerging postmodern environment. Graduates will be prepared to contribute as employees and citizens to the state of Virginia, the United States, and indeed the world as all levels of society seek better ways to live and work together in the increasingly diverse contexts of the twenty-first century in which religion and culture will continue to interact in dramatic and changing ways.

Most students who choose this major are more interested in developing complex problem solving skills, critical thinking, and acquiring a broad education, than in gaining specialized skills for a single occupation. The global focus of the major affords career opportunities in education, business, government, industry, and the service and non-profit sectors. The major has a strong academic and career-advising component.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

### Study Abroad

Students are strongly encouraged to complete an approved study abroad program outside of the U.S. Study abroad programs are occasionally run by faculty in the department.

### Honors College

Eligible students are encouraged to participate in the University Honors Program. Completing a degree "In Honors" is an excellent way for outstanding students to integrate the knowledge from several disciplines. Honors students have considerable flexibility in completing the degree requirements.

## Double Majors

For information on earning a double major or second degree, contact the Department Chair. Since a requirement for the Religion and Culture major is completing a university minor or second major, students are encouraged to earn a second major.

## Religion and Culture Minors

The department offers the following minors. Additional information about each can be found on our website at <http://liberalarts.vt.edu/academics/majors-and-minors.html>. [Note: the department's list of minors was removed by the College and replaced by a college-wide list.] Students in any major may opt to declare them as minors.

- American Studies
- Appalachian Studies
- Asian Area Studies
- Judaic Studies
- Medieval and Early Modern Studies
- Middle East Studies
- Popular Culture
- Religion

### American Studies

American studies is an interdisciplinary field that draws upon a number of academic disciplines, including history, literature, and sociology, to consider relationships between culture and society in the United States as it is embedded in global processes and issues.

**Coordinator: Emily Satterwhite**

### Appalachian Studies

Appalachian Studies is an academic program supporting teaching, research, outreach, and service on topics pertaining to Appalachia in relation to pertinent transglobal issues. Appalachian Studies faculty focus on these issues from a critical regionalism perspective in which the relationship between these issues and region is considered problematic and open to investigation.

The minor offers opportunities for community research, internships, and service-learning.

**Director: Anita Puckett**

### Asian Area Studies

The interdisciplinary minor in Asian Area Studies focuses on the great cultural traditions of the Middle East, South Asia (including India), East Asia (China, Japan, Korea), Southeast Asia, and Central Asia. Students explore how various Asian traditions explain and represent this experience in literature, philosophy, religion, history, the social sciences, and the arts.

**Coordinators: Zhange Ni and Helen Schneider**

### Judaic Studies

Endowed in 1996, the Malcolm and Diane Rosenberg Program in Judaic Studies offers students the opportunity to explore, examine, and critically engage the rich and multifaceted history, religion, and culture of the Jewish people. Judaic culture has significantly contributed to Western and other civilizations.

**Coordinator: Brian Britt**

## Medieval and Early Modern Studies

Medieval & Early Modern Studies fosters an interdisciplinary approach to the Medieval and Early Modern Worlds (roughly 300-1700 C.E.).

**Coordinator: Matthew Gabriele**

## Middle East Studies

The interdisciplinary minor in Middle East Studies allows students to gain a broad understanding and appreciation of the languages, religions, and cultures of the Middle East and of the region's history and its place in international relations.

**Coordinator: Rachel M. Scott**

## Popular Culture

The Minor in Popular Culture provides an understanding of the broadly shared cultures made possible by mass production. Popular culture includes all widely practiced and distributed expressions: news; entertainment; religion; sports; popular art; and styles of decoration, dress, and architecture.

**Coordinator: Emily Satterwhite**

## Religion

By examining a diversity of traditions and viewpoints, a program in religious studies provides the resources for an intellectually responsible appraisal of one's own value commitments. A minor in Religion is part of a broad liberal arts education and may lead to graduate study in a variety of fields or to professional training in ministerial or social service vocations.

**Coordinator: Zhange (Nicole) Ni**

## Undergraduate Course Descriptions (APS)

### 1704 (HUM 1704): INTRODUCTION TO APPALACHIAN STUDIES

Traces the idea of Appalachia in American and world consciousness and its expression in the humanities and social sciences. Through comparison with other cultural groups, explores humanistic problems of cultural identity, race and ethnicity, globalization and place-based economic relations, and the bio-cultural impact of massive natural resource extraction. (3H,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2974H: INDEPENDENT STUDY

Honors Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3464 (AHRM 3464) (GEOG 3464) (HD 3464) (HUM 3464) (SOC 3464) (UAP 3464): APPALACHIAN COMMUNITIES

The concept of community in Appalachia using an interdisciplinary approach and experiential learning. Interrelationships among geographically, culturally, and socially constituted communities, public policy, and human development. Pre: Junior standing. (3H,3C)

### 4034 (SOC 4054): APPALACHIAN LANGUAGES AND CULTURES

An empirical examination of how Appalachian speech both reflects and constitutes regional cultures. Emphasis is on applying sociological and anthropological methods and theories to the study of language in use. (3H,3C)

#### 4094 (SOC 4094): APPALACHIAN COMMUNITY RESEARCH

Undergraduate participatory community research as applied to issues of cultural heritage, sustainability, and identity. Students engage in projects defined by community groups and organizations as being critical to their well-being, continuity, or growth. Emphasis is on developing concepts of civic professionalism and developmental democracy. (3H,3C)

#### 4404 (HUM 4404): APPALACHIAN FOLK CULTURES

Examination of informal learning systems, non-commodified socioeconomic systems, and traditional aesthetic expressions in Appalachia. Investigation of cultural resistance to globalized market economies as expressed in traditional artifacts and customs. Pre: Junior standing. (3H,3C)

#### 4414 (HUM 4414): ISSUES IN APPALACHIAN STUDIES

Topics course that examines major issues affecting sustainability and continuity of contemporary Appalachia. Focus is on problems of exploitation of human and natural resources. Comparison is made to other mountain communities worldwide. Specific topics vary. May be repeated one time with different topics. Pre: HUM 1704. (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Honors Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Honors Variable credit course.

## Undergraduate Course Descriptions (HUM)

#### 1324: INTRODUCTORY HUMANITIES: THE MODERN WORLD

The shifts in thought and values over the past century in the Western imagination. Emphasis on the interrelationships among the arts, literature, philosophy, history, religion, and science, and their contributions toward shaping the values and aspirations of the age. (3H,3C)

#### 1604: INTRODUCTION TO HUMANITIES AND THE ARTS

Explores the verbal, visual, and aural arts of several important periods in Western history, setting them in the context of their times. Introduces the structural principles of each art form. (3H,3C)

#### 1704 (APS 1704): INTRODUCTION TO APPALACHIAN STUDIES

Traces the idea of Appalachia in American and world consciousness and its expression in the humanities and social sciences. Through comparison with other cultural groups, explores humanistic problems of cultural identity, race and ethnicity, globalization and place-based economic relations, and the bio-cultural impact of massive natural resource extraction. (3H,3C)

#### 2104 (AINS 2104) (COMM 2104): ORAL TRADITIONS AND CULTURE

Examination of the world's great oral traditions, both ancient and contemporary. Emphasis on performance contexts, relationships among multicultural traditions, including American Indian oral traditions, and the relationships among orality, literacy, technology, media, and culture. (3H,3C)

#### 2204: HUMANITIES AND THE ARTS: THE CREATIVE PROCESS

Explores the theory and the experience of the creative process. Studies both essays on the process of creative activity and examples of its product. Includes a personal creative project. (3H,3C)

**2504 (RLCL 2504): INTRODUCTION TO AMERICAN STUDIES**

Methodology and tools of American Studies, emphasizing interrelations among social, cultural, and technological history, values, and artistic creation. Intensive study of a specific topic or period in American culture since 1850. (3H,3C)

**2964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3034 (COMM 3034) (RLCL 3034): THEORIES OF POP CULTURE**

Relationship of popular culture to communication; ways to classify, analyze, and evaluate popular culture; history of main themes with emphasis on the United States; cultural evolution of the electronic revolution. (3H,3C)

**3044: TOPICS HUMANITIES AND ARTS**

Focuses on interdisciplinary topics involving interrelationships among various arts and/or artists. Explores the religious and/or cultural impacts of arts and/or artists on societies and of societies on artistic expression. Investigates humanistic debates about the nature of art. May be taken a maximum of 3 times for credit with different topics. (3H,3C)

**3204 (COMM 3204) (RLCL 3204): MULTICULTURAL COMMUNICATION**

Exploration of communication in various cultural groups through the medium of performance. Emphasis on understanding cultural differences and similarities in styles of communication, aesthetics, worldviews, and values. (3H,3C)

**3464 (AHRM 3464) (APS 3464) (GEOG 3464) (HD 3464) (SOC 3464) (UAP 3464): APPALACHIAN COMMUNITIES**

The concept of community in Appalachia using an interdisciplinary approach and experiential learning. Interrelationships among geographically, culturally, and socially constituted communities, public policy, and human development. Pre: Junior standing. (3H,3C)

**3504 (HIST 3504) (RLCL 3504): THE AGE OF THE CRUSADES**

The origins and development of religious violence examined from an interdisciplinary and cross-cultural perspective; the place of that phenomenon in medieval society. Christianity, Islam, Judaism and their interactions in the medieval world. (3H,3C)

**3704 (JUD 3704) (RLCL 3704): CHRISTIANS, JEWS, AND THE IDEA OF JUDEO-CHRISTIANITY**

The relationship between Judaism and Christianity through time and the idea of Judeo-Christianity, all examined from an interdisciplinary academic perspective; the problems of the "separation" of Judaism and Christianity in antiquity and the Middle Ages and the religious and cultural implication of the relationship between Jews and Christians in the modern world. (3H,3C)

**3954: STUDY ABROAD**

Variable credit course.

**4034 (COMM 4034) (RLCL 4034): FUNCTIONS OF POPULAR CULTURE**

Popular culture as a humanistic discipline; emphasis on archetypes, formulas, and genres; the function of ideas, images, and icons on the popular imagination. (3H,3C)

**4104: EXPLORATIONS IN ADVANCED HUMANITIES TOPICS**

In-depth study of special interdisciplinary topic. Topics vary but involve a close and extensive study of the

interrelationship between cultural ideas and their expressions in several of the following forms: literature, philosophy, religion, art, music, drama, material culture, and popular culture. May be repeated with different topics, for a maximum of 9 credits. (3H,3C)

**4404 (APS 4404): APPALACHIAN FOLK CULTURES**

Examination of informal learning systems, non-commodified socioeconomic systems, and traditional aesthetic expressions in Appalachia. Investigation of cultural resistance to globalized market economics as expressed in traditional artifacts and customs. Pre: Junior standing. (3H,3C)

**4414 (APS 4414): ISSUES IN APPALACHIAN STUDIES**

Topics course that examines major issues affecting sustainability and continuity of contemporary Appalachia. Focus is on problems of exploitation of human and natural resources. Comparison is made to other mountain communities worldwide. Specific topics vary. May be repeated one time with different topics. Pre: 1704. (3H,3C)

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.

## Undergraduate Course Descriptions (JUD)

**1104 (HEB 1104): INTRODUCTION TO HEBREW LANGUAGE, CIVILIZATION AND CULTURE**

Fundamentals of Modern Hebrew language with emphasis on grammar, reading, composition, and conversation. For students with no prior knowledge of the language. (3H,3C)

**1114 (HEB 1114): ACCELERATED ELEMENTARY HEBREW LANGUAGE**

Complementary introduction to the fundamentals of Modern Hebrew language with continued emphasis on grammar, reading, composition, and conversation. This course is for students who have completed 1104 or with permission from instructor. 1114 is a four-credit course with a self-instruction component that demands student time outside of class. Pre: 1104. (3H,2L,4C)

**2134 (RLCL 2134): JUDAISM: A SURVEY OF HISTORY, CULTURE, AND HERITAGE**

A thematic and historical introduction to ancient, medieval, and modern Judaism, up to the founding of the State of Israel. Themes will include monotheism, exile, mysticism, Kabbala, Hasidism, anti-Semitism, the Holocaust, and Judaism in Israel and America. (3H,3C)

**2414 (RLCL 2414): HEBREW BIBLE/OLD TESTAMENT**

Introduction to the academic study of the Hebrew Bible (Old Testament); a variety of scholarly approaches to the Bible, including historical-critical, literary, and gender studies. Emphasis on developing skills in critical thinking, reading, and writing about the Bible. (3H,3C)

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3404 (RLCL 3404): TORAH AND TRADITION

Detailed study of the first five books of the Bible, known as the Torah or Pentateuch. Scholarly approaches will include historical-critical research; comparative mythology; form and canon criticism; gender and literary studies; and the reception of these books in the Hebrew Bible, the New Testament and beyond. Pre: REL 2414. (3H,3C)

#### 3494 (HIST 3494) (RLCL 3494): THE HOLOCAUST

This course provides a historical account, a psychological analysis, and an occasion for philosophical contemplation on the Holocaust. We will examine the deliberate and systematic attempt to annihilate the Jewish people by the National Socialist German State during World War II. Although Jews were the primary victims, Gypsies, the handicapped, homosexuals, Jehovah's Witnesses and political dissidents were targeted; we will discuss their fate as well. The class will be organized around the examination of primary sources: written accounts, photographic and film, personal testimony. (3H,3C)

#### 3544 (PSCI 3544) (RLCL 3544): THE STATE OF ISRAEL: A POLITICAL HISTORY

This course provides a survey on the political history of the State of Israel and highlights major themes uniquely characterizing the specific events surrounding its establishment and its first 50 years of existence. Additionally, the course will add a comparative dimension by using the political history of Israel as a case study to discuss major themes in political science such as democracy, government, political economy, etc. Pre: 2134 or PSCI 1024. (3H,3C)

#### 3704 (RLCL 3704): CHRISTIANS, JEWS, AND THE IDEA OF JUDEO-CHRISTIANITY

The relationship between Judaism and Christianity through time and the idea of Judeo-Christianity, all examined from an interdisciplinary academic perspective; the problems of the "separation" of Judaism and Christianity in antiquity and the Middle Ages and the religious and cultural implication of the relationship between Jews and Christians in the modern world. (3H,3C)

#### 4424: ADVANCED TOPICS IN JEWISH CULTURE, HISTORY & THOUGHT

Selected topics in Jewish culture, history and thought. The courses will focus on a variety of more advanced and more specific issues than those offered in JUD 3424. These courses will be held as an in-depth seminar in affiliation with the Honor Student's Program. Possible topics includes: the Philosophy of Maimonides, Spinoza or Buber, or a course dedicated to one of the following topics Kabbalah, Hasidism, The American Jewish experience in the first half of the 20th century, and Oriental Jewish art and folklore. Two JUD courses or senior standing required. Alternate years. (3H,3C)

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (RLCL)

#### 1004: INVESTIGATIONS IN RELIGION AND CULTURE

Introduction to the study of religion and culture through multiple academic approaches in humanities and social sciences. Critical investigations of appropriate issues through scholarly collaboration, with emphasis on reading, discussions, and undergraduate research. (3H,3C)

#### 1024: JUDAISM, CHRISTIANITY, AND ISLAM

The nature of "religion," approaches to understanding "religion," traditional and contemporary features of Judaism, Christianity, and Islam, including their manifestations in the USA and their involvements in critical issues in a global context. (3H,3C)

#### 1024H: JUDAISM, CHRISTIANITY, ISLAM

The nature of "religion" approaches to understanding "religion," traditional and contemporary features of Judaism, Christianity, and Islam, including their manifestations in the USA and their involvements in critical issues in global context. (3H,3C)

#### 1034: RELIGION AND THE MODERN WORLD

Modern challenges to traditional and responses to these challenges, including conservative, liberal, and radical responses; science and religion; issues of race and gender; church and state issues. (3H,3C)

#### 1034H: RELIGION AND THE MODERN WORLD

Modern challenges to traditional and responses to these challenges, including conservative, liberal, and radical responses; science and religion; issues of race and gender; church and state issues. (3H,3C)

#### 1044: RELIGIOUS ETHICS

Influential representative social and religious ethical perspectives from the mid-sixties to the present; ethical reasoning on current pressing and perennial social issues based on historical and ethical analysis of case studies; theoretical assumptions about morality as the relation between justice and the good. (3H,3C)

#### 1134 (CLA 1134): INTRODUCTORY HUMANITIES: THE ANCIENT MEDITERRANEAN WORLD

Ancient Greek, Hellenistic, and Roman cultures through their embodiments in the arts, literature, history, philosophy, and religion. Emphasis on the interrelationships among the various forms of cultural expressions and material and intellectual encounters among diverse groups in the ancient Mediterranean world. (3H,3C)

#### 1214: INTRODUCTORY HUMANITIES: THE MEDIEVAL WORLD

The medieval synthesis in Western European thought and the transition to the world of the Renaissance. Emphasis on the interrelationships among the arts, literature, philosophy, history, religion, and science, and their contributions toward shaping the values and aspirations of the age. (3H,3C)

#### 1214H: MEDIEVAL

The medieval synthesis in Western European thought and the transition to the world of the Renaissance. Emphasis on the interrelationships among the arts, literature, philosophy, history, religion, and science, and their contributions toward shaping the values and aspirations of the age. (3H,3C)

#### 1904: RELIGION AND CULTURE IN ASIA

Historical and geographical overview of diverse religious/cultural traditions in Asia. Investigation of the categories "religion" and "culture" and their interactions in Asia Examination of different methodological and interdisciplinary approaches and their integration, with emphasis on critical thinking about the complexities of studying religion and culture in Asia. (3H,3C)

#### 2004: CASE STUDIES IN RELIGION AND CULTURE

Significant case studies in the study of religion and culture with an emphasis on influential and emerging research. Focused engagement with humanities and social sciences research grounded in analysis, comparison, and evaluation of relevant case studies. (3H,3C)

#### 2054 (SOC 2054): ETHNOGRAPHY: STUDYING CULTURE

Introduction to the methodological tools used by anthropologists and other social scientists to study culture. Engagement with the development of, and debates about, ethnographic methods, as well as their application to case studies. Focus on analyses of sample ethnographic accounts of peoples throughout the world, as well as research techniques applicable to many different cultural environments. (3H,3C)

#### 2104 (GR 2104): GREEK NEW TESTAMENT



Readings from the New Testament in Greek, with attention to grammatical analysis, historical background and other clues interpretation. May repeated with different content for a maximum of 9 credits. Pre: GR 1106. (3H,3C)

#### 2124: RELIGION IN AMERICAN LIFE

The role of religion in American life in selected periods from the original settlements to the present; the influence of religious institutions and movements in American history and the impact of the "American experience" on religious life and expression. (3H,3C)

#### 2134 (JUD 2134): JUDAISM: A SURVEY OF HISTORY, CULTURE, AND HERITAGE

A thematic and historical introduction to ancient, medieval, modern Judaism, up to founding of the State of Israel. Themes will include monotheism, exile, mysticism, Kabbala, Hasidism, anti-Semitism, the Holocaust, and Judaism in Israel and America. (3H,3C)

#### 2144 (AFST 2144): AFRICAN RELIGIONS

The role of religious (or belief) systems in African societies, especially the three predominant religious traditions in Africa: the so-called African Traditional Religious, Islam, and Christianity; the universe of religious systems and religious experiences and processes of Africa, in particular, Sub-Saharan Africa; critical examination of the mythic stature of Africa's "religions" within Western cultural (and scholarly) world views and institutions. (3H,3C)

#### 2204 (AFST 2204) (WGS 2204): RACE AND GENDER IN RELIGION AND CULTURE

Introduction to how race and gender influence and are influenced by religion and culture. Overview of approaches to categories of diversity, particularly race and gender, in religious and cultural traditions. Utilization of humanistic and social scientific approaches to investigate geographically variable historical and/ or contemporary case studies. (3H,3C)

#### 2324: ISLAM

The rise of Islam under the Prophet Muhammad in Arabia and its spread across Asia and Africa. The development of Islam in the middle Ages and its resurgence in the 20th century. (3H,3C)

#### 2414 (JUD 2414): HEBREW BIBLE/OLD TESTAMENT

Introduction to the academic study of the Hebrew Bible (Old Testament); a variety of scholarly approaches to the Bible, including historical-critical, literary, and gender studies methods. Emphasis on developing skills in critical thinking, reading, and writing about the Bible. (3H,3C)

#### 2424: NEW TESTAMENT

Introduction to the academic study of the New Testament; a variety of scholarly approaches to the New Testament; including historical-critical, redaction critical, and literary methods. Emphasis on developing skills in critical thinking, reading, and writing about the New Testament as a way of understanding the faith and history of early Christianity. (3H,3C)

#### 2424H: NEW TESTAMENT

Introduction to the academic study of the New Testament; a variety of scholarly approaches to the New Testament, including historical-critical, redaction critical, and literary methods. Emphasis on developing skills in critical thinking, reading, and writing about the New Testament as a way of understanding the faith and history of early Christianity. (3H,3C)

#### 2444 (CLA 2444) (ENGL 2444): GREEK AND ROMAN MYTHOLOGY

Survey of Ancient Greek and Roman mythology and modern interpretations. In English. No knowledge of Ancient Greek or Latin Required. Not for credit toward a Latin Minor. (3H,3C)

#### 2464 (STS 2464): RELIGION AND SCIENCE

Exploration of the relationships between religion and science in the western tradition. Topics include: basic frameworks for relationships between religion and science in historical and cultural context, types of human knowledge and truth, similarities and differences between science and religion, evolution, ecology, and contemporary issues. (3H,3C)

#### 2474 (IS 2474): RELIGION AND VIOLENCE

Investigation of the categories of religion and secularity as they apply to war and peace. Analysis of episodes from both past and present in which religion seems to have played a role. Introduction to research skills related to the study of religion and violence, building from theoretical and historical considerations. (3H,3C)

**2504 (HUM 2504): INTRODUCTION TO AMERICAN STUDIES**

Methodology and tools of American Studies, emphasizing interrelations among social, cultural, and technological history, values, and artistic creation. Intensive study of a specific topic or period in American culture since 1850. (3H,3C)

**2514 (SOC 2514): ASIAN AMERICAN EXPERIENCE**

Critical overview of diverse Asian-American experience, the complexity of minority status, and meaningful citizenship in the USA. Topics include different historical tracks of various Asian ethnicities, experience of racism, activism, cultural adaptation and conflict, and economic survival and success. (3H,3C)

**2964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**2974: INDEPENDENT STUDY**

Variable credit course.

**2974H: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3014 (WGS 3014): WOMEN AND GENDER IN ISLAM**

An examination of women and gender in Islam from a variety perspectives including Muslim women in Islamic history, normative constructions of the role of women in Islam, and women's roles in contemporary Muslim societies. Understanding of women in classical Islam; feminist and reformist approaches; and Western constructions of the "rights of women if Islam." (3H,3C)

**3024 (ENGL 3024): RELIGION AND LITERATURE**

Analysis of literary works and critical debates in such areas as: pilgrimage, myth, disaster, and transcendence. Students will make presentations, develop their own research projects, and design sessions with short reading assignments later in the semester. As a final project, students will assemble a portfolio charting their work in the course. (3H,3C)

**3034 (COMM 3034) (HUM 3034): THEORIES OF POP CULTURE**

Relationships of popular culture to communication; ways to classify, analyze, and evaluate popular culture; history of main themes with emphasis on the United States; culture evolution of the electronic revolution. (3H,3C)

**3144 (ENGL 3144) (SOC 3144): LANGUAGE AND ETHNICITY IN THE UNITED STATES**

Exploration of how racial and ethnic identity are expressed through the use of different languages and dialects. Examination of how language is related to issues of equality, social opportunity, and discrimination in the United States. Pre: ENGL 1106 or ENGL 1204H or COMM 1016. (3H,3C)

**3204 (COMM 3204) (HUM 3204): MULTICULTURAL COMMUNICATION**

Exploration of communication in various cultural groups through the medium of performance. Emphasis on understanding cultural differences and similarities in styles of communications, aesthetics, worldviews, and values. (3H,3C)

**3214: RELIGION AND CULTURE IN INDIA**

Interaction of religion and culture from Indus Valley civilization to the present; Brahmanism and Hinduism, the Buddha and his teachings, Parsis, Jains, Sikhs, and their respective literatures and rituals; modern reforms and recent trends. (3H,3C)

#### 3224: RELIGIONS OF CHINA AND JAPAN

Religious movements in East Asia with reference to specific situations in China and Japan; Confucianism, Taoism, Mahayana, Buddhism, Vajrayana, Shinto, Japanese Folk Religions, the "New Religions" of Japan; recent trends. (3H,3C)

#### 3404 (JUD 3404): TORAH AND TRADITION

Detailed study of the first five books of the Bible, known as the Torah or Pentateuch. Scholarly approaches will include historical-critical research; comparative mythology; form and canon criticism; gender and literary studies; and the reception of these books in the Hebrew Bible, the New Testament, and beyond. Pre: 2414. (3H,3C)

#### 3414: JESUS AND THE GOSPELS

Academic study of the four canonical Gospels; Matthew, Mark, Luke, John; several scholarly methodologies; the problem of the historical Jesus; noncanonical gospels. Pre: 2424. (3H,3C)

#### 3424: PAUL AND HIS INTERPRETERS

Academic study of the New Testament letters by or attributed to Paul; historical, literary, and theological context of the letters; classic and contemporary interpreters. Pre: 2424. (3H,3C)

#### 3494 (HIST 3494) (JUD 3494): THE HOLOCAUST

This course provides a historical account, a psychological analysis, and an occasion for philosophical contemplation on the Holocaust. We will examine the deliberate and systematic attempt to annihilate the Jewish people by the National Socialist German State during World War II. Although Jews were the primary victims, Gypsies, the handicapped, homosexuals, Jehovah's Witnesses and political dissidents were targeted; we will discuss their fate as well. The class will be organized around the examination of primary sources: written accounts, photographic and film, personal testimony. (3H,3C)

#### 3504 (HIST 3504): THE AGE OF THE CRUSADES

The origins and development of religious violence examined from an interdisciplinary and cross-cultural perspective; the place of that phenomenon in medieval society. Christianity, Islam, Judaism and their interactions in the medieval world. (3H,3C)

#### 3544 (JUD 3544) (PSCI 3544): THE STATE OF ISRAEL: A POLITICAL HISTORY

This course provides a survey on the political history of the State of Israel and highlights major themes uniquely characterizing the specific events surrounding its establishment and its first 50 years of existence. Additionally, the course will add a comparative dimension by using the political history of Israel as a case study to discuss major themes in political science such as democracy, government, political, economy, etc. Pre: JUD 2134 or PSCI 1024. (3H,3C)

#### 3604: ISLAM AND THE MODERN WORLD

Issues facing the contemporary Islamic world, with a focus on the Islamic resurgence and the concept of Jihad. Muslims re-formulate the Islamic tradition as a response to the pressures of modernity. (3H,3C)

#### 3704 (JUD 3704): CHRISTIANS, JEWS, AND THE IDEA OF JUDEO-CHRISTIANITY

The relationship between Judaism and Christianity through time and the idea of Judeo-Christianity, all examined from an interdisciplinary academic perspective: the problems of the "separation" of Judaism and Christianity in antiquity and the Middle Ages and the religious and cultural implications of the relationship between Jews and Christians in the modern world. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4024 (SOC 4024): SOCIOLOGY OF RELIGION

Religion as a social structure as well as an institution; with special attention to the functions of religion for individuals, groups and societies, social organization; and the interplay between religion and other social institutions including economics and polity. Taught alternate years. Pre: SOC 1004. (3H,3C)

#### 4034 (COMM 4034) (HUM 4034): FUNCTIONS OF POPULAR CULTURE

Popular culture as a humanistic discipline; emphasis on archetypes, formulas, and genres; the function of

ideas, images, and icons on the popular imagination. (3H,3C)

**4124 (SOC 4124) (WGS 4124): TOPICS IN CULTURE**

Uses sociological, anthropological, as well as artistic and humanist paradigms to analyze culture. Discusses 20th and 21st century cultural trends. Analyzes the implications of social context for cultural artifacts such as art. Topics are variable. Example topics include the cultural construction of race and the culture of the nineteen sixties. Course may be repeated with different course content for up to 6 credits. Junior or Senior standing. Pre: SOC 1004 or SOC 1014 or AFST 1714 or AINS 1104 or RLCL 1004 or RLCL 2004 or WGS 1824. (3H,3C)

**4324: TOPICS IN RELIGION AND CULTURE**

Selected topics from the religions of the world such as time and the sacred, preliterate religions, women and religion, religion and science, mysticism. May be taken three times for credit with different topics. Pre: 2004. (3H,3C)

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

### Sustainable Biomaterials

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[Packaging Systems and Design](#)

[Sustainable Biomaterials](#)

[Wood Science and Forest Products Minor and Packaging Science Minor](#)

[Undergraduate Course Descriptions \(SBIO\)](#)

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**Head:** R. L. Smith

**Professors:** B.H. Bond, U.K. Buehlmann, R.J. Bush, K.J. Edgar, C.E. Frazier, B. Goodell, A.L. Hammett, D.P. Hindman, D.E. Kline, J.R. Loferski, M. Roman, R.L. Smith, P.M. Winistorfer, and A. Zink-Sharp

**Associate Professors:** H.J. Quesada-Pineda

**Assistant Professors:** L. Horvath and Y. Kim

**Adjunct Senior Research Scientist:** P. A. Araman

**Professor Emeritus:** W.G. Glasser, M.S. White, and R.L. Youngs

Web: [www.sbio.vt.edu](http://www.sbio.vt.edu)

### Packaging Systems and Design

Learn how sustainable packaging is used to eliminate waste and pollution in the environment, how packaging design enhances products, and how smart materials are used in food and drug packaging to enhance safety and quality.

### Sustainable Biomaterials

Learn how biomaterials can be made and utilized in ways to produce better performing materials with less environmental impact. Study options include residential wood structures and forest products business.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Wood Science and Forest Products Minor and Packaging Science Minor

Minors are offered for students interested in obtaining knowledge and skills in the wood science field to supplement their primary major field of study.

## Undergraduate Course Descriptions (SBIO)

### 1234: INTRODUCTION TO WOOD, DESIGN AND CRAFTSMANSHIP

Wood as a material. Introduction to laboratory techniques, wood processing, machining and woodworking, moisture interactions, species characteristics, microscopic techniques, measuring material properties, characteristics of forest products industry, career opportunities. (2H,3L,3C)

### 2004: COMPUTER-AIDED DESIGN IN PACKAGING

Principles of Computer-Aided Design (CAD) in the packaging industry. Basics of virtual primary package development, computer-aided design of the secondary package, computer-aided optimization of truck loading and palletization. Development of a comprehensive packaging system in a virtual environment. (3H,3C)

### 2104: PRINCIPLES OF PACKAGING

Packaging systems, materials, and forms and their relationship with the requirements of global societies for the distribution and storage of industrial and consumer products; packaging laws and regulations. (3H,3C)

### 2114: PACKAGING LAW AND REGULATION

Study of the legal and regulatory issues affecting primary, secondary, and tertiary packaging and packaging systems. Labeling, food and drug, intellectual property, shipping, structural, and environmental laws and regulations affecting packaging design and use. Pre: 2104. (3H,3C)

### 2124: STRUCTURE AND PROPERTIES OF SUSTAINABLE BIOMATERIALS

Macroscopic and microscopic structure and chemical composition of wood and other biomaterials such as grasses, bamboo, and bagasse. Relationships between anatomical structure and physical/mechanical behavior. Microscopic identification of commercially important biomaterials. Preparation and analysis of microscope slides and scanning electron micrographs. Pre: BIOL 1005, CHEM 1035. (2H,3L,3C)

### 2384: BEHAVIOR OF SUSTAINABLE BIOMATERIALS

Physical properties of sustainable biomaterials and composite based on structure. Polymer science topics related to sustainable biomaterial composition. Influence of structure on transport properties, response to heat, moisture, electricity, and light. Measurement techniques and reporting for steady-state transport. Pre: CHEM 1035, PHYS 2205. (2H,3L,3C)

### 2614: INTRO FOREST PROD MARKETING

Study of marketing systems and methods used by North American primary and secondary forest product industries. Emphasis on wood product industries. Marketing of hardwood lumber, softwood lumber, panels, composites, furniture, and paper products. Role of North American industries and markets in world trade of forest products. (3H,3C)

**2784 (FOR 2784): WORLD FORESTS AND FOREST PRODUCTS**

A socio-economic approach to examining the management and use of the world's forests, enhance knowledge of global forest resources and products, and understand the roles and relationships of key stakeholders. (3H,3C)

**2974: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3004: SUSTAINABLE NATURE-BASED ENTERPRISES**

Planning for green and sustainability values for profit and non-profit enterprises that produce and market nature-based products and services (e.g., wood products, wildlife, fish, ecotourism). Understanding current green business environments to foster natural resource-based enterprises. (3H,3C)

**3114: BIODETERIORATION, BIOCONVERSION AND BIOENERGY**

Conversion of sustainable biomaterials as part of natural biological, and non-biological, processes and the use of these processes in bioenergy production and carbon cycling. Biological mechanisms and adapted processes for biomaterials conversions including fungal/bacterial/ insect and marine decomposition relative to carbon and nutrient cycling and the production of feedstocks for bioenergy and biomaterials. Deterioration and protection of biomaterials as well as bioconversion for fuels and feedstocks. Protection/preservation of biomaterials including wood, bamboo, rattan, leather, and historic objects is also included. Pre: CHEM 1035, BIOL 1115. (3H,3C)

**3124: PAPER AND PAPERBOARD PACKAGING**

Paper and paperboard properties and types. Types and performance of flexible paper packaging, sacks, and wraps. Folding carton design, properties of corrugated fiberboard. Corrugated fiberboard container design and performance. Packaging regulations and hazards of the distribution environment. Printing, labeling and automatic identification methods. Pre: 2104, 2004. (2H,3L,3C)

**3224: PACKAGING AND MATERIALS HANDLING**

Unit load and parcel supply chains. Principles of operation and design of warehouse distribution and fulfillment centers. Principles of operation and design of shipping and distribution systems. The relation between packaging design, pallet design, and unit load design and the operation of industrial consumer goods supply chain. Pre: 2104. (3H,3C)

**3234: WOOD IDENTIFICATION PROPERTIES LABORATORY**

Physical properties and characteristics of wood. Methods for determining its physical properties. Variation of the properties. Structure, properties, & processing of tropical woods. (3L,1C)

**3284: PACKAGING POLYMERS AND PRODUCTION**

Introduction to synthetic, natural and sustainable polymer science and engineering as applied to packaging systems. Morphology, rheology, physical and thermal properties, processing methods, and polymerization of traditional, natural and sustainable packaging polymers. Detailed study of relationships among materials, processing, and structural properties through hands-on experience. Both traditional and advanced industrial mass production technology, and global regulation and environmental impact of packaging articles. Pre: 2104. (2H,2L,3C)

**3314: WOOD MECHANICS**

Mechanical properties of wood including concepts of stress, strain, Poisson's ratio, orthotropic properties, tension, compression, bending and effects of moisture on mechanical properties. Current issues of wood mechanics in the wood product industry. Standard methods of evaluating important mechanical properties or solid wood, composites and fiber. Pre: 2554, (MATH 1016 or MATH 1025). (3H,3L,4C)

### 3324: GREEN BUILDING SYSTEMS

Definition of green buildings with specific focus on wood frame single family housing and appropriate green building systems. Site specification, resource efficiency, water efficiency, indoor environmental quality, homeowner education and global impact. Certification in various green building systems. (3H,3C)

### 3334: SURVEY OF NON-TIMBER FOREST PRODUCTS

In depth study of non-timber forest products of NTFP throughout Appalachia with overseas example - their heritage, uses and markets, economic development opportunities, and sustainable management. Emphasis will be placed on utilization and management issues. Students will gain skills necessary to assess and plan for NTFP business opportunities. (3H,3C)

### 3434: CHEMISTRY AND CONVERSION OF SUSTAINABLE BIOMATERIALS

Chemical composition of plant matter. Chemistry and biosynthesis of plant components. Cellulosic biofuel technology. Industrial conversion of woody biomass: pulping, bleaching, papermaking. Industrial conversion of cellulose by chemical processes. Pre: CHEM 1036. (3H,3C)

### 3444: SUSTAINABLE BIOMATERIALS & BIOENERGY

Introduction to the structure and properties of natural composites, biobased polymers, and naturally-derived chemicals for materials and energy applications. Chemistry of biomass deconstruction. Industrial applications of biobased polymers, monomers, and chemicals. Pre: (CHEM 2514 or CHEM 2535), (CHEM 3615 or CHEM 4615). (3H,3C)

### 3445-3446: ENTREPRENEURIAL WOOD DESIGN AND INNOVATION

Concept to market business project applied to design and innovation of wood products. Product design based on consumer need and sustainable use of natural resources. Writing a business plan including, product innovation, resource sustainability, marketing, strategic planning, production planning, technology utilized, packaging and distribution to final market. (2H,3L,3C)

### 3454: SOCIETY, SUSTAINABILITY BIOMATERIALS AND ENERGY

Sustainability, raw materials and energy needs of society. Use of sustainable biomaterials to meet society's needs and reduce impact on the environment. Methods to evaluate and certify the sustainability of materials and consumer goods. Carbon sequestration and the use biomass for energy. (3H,3C)

### 3464: FOREST PRODUCTS BUSINESS SYSTEMS

Business processes of forest/wood product organizations. Business challenges and current business processes and management practices. Organizational methods to study business processes and then plan, execute, and evaluate business performance improvements. The application of techniques to strategic planning, strategy deployment, value stream management, and performance assessment. Business case studies of wood products and forest products related organizations. Pre-Requisite: Junior Standing required Pre: 2614. (2H,3L,3C)

### 3534: LUMBER MANUFACTURING AND DRYING

The processing of logs into dry lumber. Principles of log and lumber grading. Design and operation of log sawing and lumber drying systems. Techniques for measuring lumber manufacturing and lumber drying efficiency. The relationship between log quality, sawing, and drying and the quality of the product produced. Pre: 3114. (2H,3L,3C)

### 3544: SECONDARY WOOD PRODUCTS MANUFACTURING

Secondary wood products manufacturing, including raw materials, rough mill, finish mill, assembly, and finishing. Also covers machinery, wood machining, plant layout, production methods, modern industrial engineering concepts in secondary manufacturing, and wood treating. Visits to local secondary wood products manufacturing industry. Pre: 3114, 3534. (2H,3L,3C)

### 3554: SUSTAINABLE BIOMATERIALS ENTERPRISES

Processes and techniques in manufacturing sustainable biomaterial-based products. Contemporary manufacturing, industrial engineering, and business practices in enterprises. Problem solving, operations management, and effective leadership in discrete products manufacturing and sustainable biomaterials production practices. Pre: 1234. (3H,3C)



#### 3634: WOOD PRODUCTS MANUFACTURING

The study of manufacturing processes used in the primary and secondary wood products industry including; lumber; wood moisture relations, drying, durability and the processing of lumber into secondary wood products such as flooring, furniture, and cabinets. Description, selection, and use of the manufacturing equipment used in wood processing. The selection and use of current industrial engineering and business practices applied in wood products manufacturing. How managers solve production and raw material issues. Pre: 2124. (2H,3L,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 3964: FIELD STUDY

Variable credit course.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4004: SENIOR SEMINAR IN FOREST PRODUCTS BUSINESS

Integrated application of principles of management, manufacturing, and marketing as applied to wood-based and related industries. Case analysis, business planning and strategic decision making. Senior standing required. Pre: 3634. (2H,2C)

#### 4024: PACKAGING DESIGN FOR GLOBAL DISTRIBUTION

Understanding, identification, and measurement of hazards in physical distribution including sea, air, and various land transportation, storage methods, and use of sanitation methods. Knowledge, analysis, and selection of sustainable protective packaging materials. Design and analysis of packaging protection against such hazards as shock, vibration compression, and climate. Laboratory testing of shock, vibration and compression, and performance testing of packaging and components. Packaging design in global context. Pre: 3224. (2H,3L,3C)

#### 4054: PACKAGING SYSTEMS DESIGN PRACTICUM

Integrated application of principles of packaging design and manufacturing. Design briefs, package development process, structural requirements, manufacturing and distribution plans, target markets and positioning. Senior Standing required. Permission of Instructor. (2H,3L,3C)

#### 4154: COMPUTER APPLICATION SYSTEMS IN FOREST PRODUCTS

Computer control systems with applications in the forest products industry. Survey of systems for gathering, inputting, conditioning, and managing information. Hardware and software systems for computer control applications. Use of information technologies to integrate control subject to raw material, quality, and market fluctuations. Forest products case studies in data acquisition, data analysis, database management production planning, process control, inventory control, and systems specification. Junior standing is required. (2H,3L,3C)

#### 4214: FOOD AND HEALTH CARE PACKAGING

Designed for both current and advanced food and health care packaging. Covering the types of materials and their properties, fabrication, functions, distribution and packaging life cycle for food and health care packaging systems and design. Reviewing recent trends in food and health care packaging systems; sustainable food packaging, medical device packaging, aseptic packaging, package/product interactions, smart active packaging, handling of packages, and modified atmospheric packaging. Exploration to global food and health care packaging standards and compliance, safety issues, and environmental considerations. Pre: 3124, 3284. (2H,2L,3C)

#### 4224: WOOD PALLET, CONTAINER, AND UNIT LOAD DESIGN

Wood pallet design and performance. The design of wood containers and crates. Design and performance of unit loads. Design and performance of unit load equipment, i.e., conveyors, racking systems, automatic guided vehicles, fork trucks. Principles of unit load design. Mechanical interactions between pallets, packaging, and unit load handling equipment. Unit load stabilization techniques, i.e., strapping, stretch wrapping. International phytosanitation regulations of solid wood packaging; principles

of dunnage, blocking and bracing. Pre: 4024, 3224. (2H,3L,3C)

#### 4314 (CNST 4314): DESIGN OF WOOD STRUCTURES

Analysis and design of wood structures comprised of solid wood and/or composite wood products. Evaluation of mechanical properties of wood materials. Design of individual tension, compression and bending members, and wood-steel dowel connections. Lateral loading design of diaphragms and shearwalls. Pre: 3314 or CEE 3404. (3H,3C)

#### 4384: BIOREFINERY SCIENCE

Biomass utilization as an industrial resource. Biorefinery processes such as cultivation, harvesting, separation, and biomass processing into industrial products compared to the petroleum refinery. Routes to the production of bioenergy, biochemicals, and biofuels. Resource availability and energy consumption, environmental implications of a biorefinery system, public policy influence on development of biorefineries. Pre: 3434. (3H,3C)

#### 4424 (CHEM 4424): POLYSACCHARIDE CHEMISTRY

Structure, properties, and applications of natural polysaccharides. Natural sources and methods of isolation. Synthetic chemistry and important polysaccharide derivatives. Relation of structure and properties to performance in critical applications including pharmaceuticals, coatings, plastics, rheology control, and films. Conversion by chemical and biochemical methods of polysaccharide biomass to fuels and materials. Pre: CHEM 2536 or CHEM 2566. (3H,3C)

#### 4444: SUSTAINABLE BIOMATERIAL COMPOSITES

Introductory polymer, adhesion, and materials science of composites made from plant materials including wood, bamboo, and straw. Composite manufacture and performance. Contemporary wood adhesives and binders. Pre: 2124, 2384, 3434. (3H,3L,4C)

#### 4514: WOOD PRODUCTS INDUSTRY STUDIES

Field studies of the processing systems and product manufacturing procedures of various wood products industries. Pre: 3114. (3L,1C)

#### 4624: WOOD INDUSTRY PRODUCTION OPERATIONS MANAGEMENT

Study of the operation of wood products organizations. Problems facing these organizations and current management practices used to address these problems. Investigation of the design and implementation of wood industry management improvement efforts. How organizations and groups design, implement, and evaluate improvements efforts. The application of techniques to production planning, financial management, inventory management, quality, human resources management, technology, performance measures, and assessment. Includes case studies of wood products manufacturing companies. Pre: 3544. (2H,3L,3C)

#### 4634: FOREST PRODUCTS BUSINESS MANAGEMENT

This course will describe the allocation of resources within a forest products business. Students will determine how to allocate natural, human and financial resources to maximize profitability within the organization. How allocation decisions affect all stakeholders of the organization will be demonstrated and this allocation's impact upon strategic planning will be discussed. The course will also show the impact of the external business environment on management decisions. Pre: 1234, 2614, 3114. (3H,3C)

#### 4714: WOOD PERFORMANCE IN CONSTRUCTION

Interactions of building code requirements, wood materials and building construction with special emphasis on relative merit of wood and wood-based composites versus non-wood alternatives. Construction details that lead to long-term performance such as controlling moisture infiltration, preservatives, and proper selection of materials, preservation of historic wood buildings, effectiveness and efficiency of wood building systems. Pre: 4315. (3H,3C)

#### 4715,4716: WOOD HOUSE

4715: Principles of manufacturing sustainable biomaterials into primary and secondary products used in construction of wood buildings, houses and in manufacture of wood consumer goods used in housing. Raw material estimation, lumber production, veneering, composite and paper products. 4716: The use of

manufactured wood materials in the construction of wood buildings. Interactions of building code requirements, wood and wood composite materials as sustainable biomaterial components within houses. Durability, deterioration, controlling moisture infiltration, preservatives and proper selection of materials, historic wood buildings, effectiveness and efficiency of wood building systems. Pre: 3314. (3H,3C)

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Sociology

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**Chair:** John Ryan

**Professors:** O. Agozino, D. Brunsma, T. M. Calasanti, T. D. Fuller, L. Gillman, J. Hawdon, M. Hughes, J. Kiecolt, N. King, J. Ryan, W. Reed, D. J. Shoemaker, and B. E. Smith

**Associate Professors:** C. A. Bailey, S. R. Cook, K. Harrison, A. Peguero, P. Polanah, P. Seniors, A. Vogt Yuan, and D. W. Wimberley

**Assistant Professors:** N. Copeland, C. Labuski, S. Ovink, P. Rivera-Rideau, S. Samanta, and H. Zhu

**Adjunct Professors:** R. Blieszner, D. Breslau, G. L. Downey, N. McGehee, P. D. Metz, K. Moore, and J. M. Shepard

**Advanced Instructor:** E.T. Graves

**Instructors:** D. Sedgwick

**Career Advisor:** D. Sedgwick

**Academic Advisor:** B. Husser

**Distinguished Professor Emeritus:** W. E. Snizek

**Emeritus Professors:** J. A. Ballweg, C. Burger, C. J. Dudley, J. N. Edwards, B. R. Hertel,

and J. W. Michaels

Web: [www.sociology.vt.edu](http://www.sociology.vt.edu)

## Overview

The Department of Sociology offers a B.S., M.S., and Ph.D. Sociology is the home to two majors, sociology and criminology, and to programs in Africana Studies (AFST), American Indian Studies (AINS), Women's and Gender Studies (WGS), the Center for Peace Studies and Violence Prevention (CPSVP) and the Center for Race & Social Policy Research (RSP). Courses are open to students in all colleges of the university.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Sociology Major

In addition to fulfilling the requirements of the General Education (Curriculum for Liberal Education), sociology majors must complete 44 hours in sociology, including: 22 hours of sociology core courses and 18 hours of sociology electives, with no more than six hours at the 1000-2000 level and at least nine hours at the 4000 level. In addition, students must take 1 hour of First Year Experience (SOC 1024) and 3 hours in Africana Studies, American Indian Studies, Peace Studies and Violence Prevention or Women's and Gender Studies at the 3000 or 4000 level.

Sociology majors may select options in Africana studies, American Indian studies, research methods, social inequality, and women's and gender studies. Each option has its own course requirements. Please request additional information from the department office.

## Criminology Major

In addition to fulfilling the requirements for the General Education (Curriculum for Liberal Education), criminology majors must complete 44 hours in criminology, including: 22 hours of sociology core courses, 1 hour of First Year Experience, 9 hours of required criminology courses, and 12 hours of elective criminology courses.

## Minors

Minors in sociology must complete 18 hours in sociology including Introduction to Sociology (SOC 1004).

No more than nine hours at the 1000-2000 level will count toward a minor. A minimum GPA of 2.0 for courses in the minor is required. Sociology offers a minor in Africana Studies, American Indian Studies, Diversity and Community Engagement, Gender, Science and Technology, Peace Studies and Violence Prevention, Sociology, Women's and Gender Studies, and Women's Leadership. See the listing of the programs below for further information.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Sociology.

Satisfactory progress requirements toward the B.S. in Sociology can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Africana Studies Program

**Director:** Ellington Graves

**Professors:** O. Agozino (Africana Studies) and W. Reed (Africana Studies)

**Gloria Smith Endowed Professor:** K. Harrison (Africana Studies/Sociology)

**Associate Professors:** K. Harrison (Africana Studies/Sociology), P. Polanah, and P. Seniors

**Assistant Professors:** P. Rivera-Rideau

**Affiliated Faculty:** N. Giovanni (English), R. Graham (Art), L. Roy (English), V. Fowler (English), B. Bunch-Lyons (History), E. Graves (Sociology), M. Herndon (Distance Learning), B. Shadle (History), and V. White (School of Visual Arts)

Africana Studies is an interdisciplinary field of study that uses concepts and methodologies of the Social Sciences and the Humanities, centering on the study of peoples of African descent. The program cooperates with faculty from across the university, whose teaching and research is concerned with Africa and the African diaspora. Africana Studies supports the university's objective to increase the numbers of students and faculty of color. It also engages with other programs and organizations in community awareness activities that celebrate the richness and diversity of African diasporic cultures and traditions. An Africana Studies minor is open to all students who are interested in learning about the issues covered in the AFST program.

The Africana Studies program offers a minor in Africana Studies. The minor allows the student to focus their study on African Americans or continental Africa.

## American Indian Studies: A Holistic Approach

**Director:** Samuel R. Cook

**Associate Professor:** S. Cook

**Assistant Professor:** N. Copeland

A program in the Department of Sociology, we offer several courses and a minor in American Indian Studies.

We believe that any successful American Indian Studies program must do more than simply educate a general student body on American Indian cultures and issues in a sensitive way. We believe that our curricula must exist in conjunction with all university programs pertinent to American Indians, and must depend on the impetus of indigenous peoples working within and beyond the university.

In keeping with Virginia Tech's status and mission as a land grant institution, we strive to serve our indigenous constituency, both as educators and as partners. Accordingly, our program serves as a vital conduit for university-tribal relations, the recruitment and retention of American Indian students and

faculty, and Service-Learning initiatives in indigenous communities. Although our program has a regional focus, we offer a wide spectrum of courses--ranging from American Indian Literatures, American Indian Spirituality, and American Indian Arts, to native Peoples of the Southeast, American Indians in Film, and Global indigenous Rights--reflecting the impressive and diverse expertise of our faculty.

In short, we embrace a holistic, collaborative approach to American Indian Studies in which university faculty and students develop and maintain meaningful partnerships. Accordingly, we maintain a tribal advisory board consisting of elders and leaders from all of Virginia's eight Indian Nations. We regard these representatives, and ultimately, all indigenous peoples as our colleagues.

## Women's and Gender Studies Program

**Director:** Katrina Powell

**Professors:** B. E. Smith, A. Kilkelly, and L. Gillman

**Associate Professors:** N. M. King and K. Powell

**Assistant Professors:** C. Labuski and S. Samanta

**Visiting Assistant Professor:** A. Neff

**Instructor:** M. Sharma

### Affiliated Faculty

**Professors:** O. Agozino (Africana Studies); K. Allen (Human Development); R. Blieszner (Human Development); C. Burch-Brown (Art); T. Calasanti (Sociology); E. Creamer (Educational Leadership and Policy Studies); K. DePauw (Graduate School, Sociology, Human Nutrition, Foods, and Exercise); G. Downey (Science and Technology in Society); E. Ewing (History); E. Fine (Interdisciplinary Studies); V. Fowler (English); B. Hausman (English); A. Kilkelly (Theater Arts); I. Luciak (Political Science); P. Meszaros (Human Development); E. Plummer (Office of Provost); J. Rothschild (Government and International Affairs); L. Roy (English); S. Ott Rowlands (CLAHS); K. Singh (Education); D. Stoudt (CLAHS); A. Zvonkovich (Human Development)

**Associate Professors:** K. Belanger (English); S. Carter-Tod (English); C. Dannenberg (English); W. Dunaway (Government and International Affairs); April Few-Demo (Human Development); S. Fowler (Graduate Education Development Initiative, English); S. Halfon (Science & Technology Studies); S. Johnson (Foreign Languages and Literatures); K. Jones (History); S. Knapp (English); M. Mollin (History); K. Powell (English); E. Satterwhite (Religion & Culture); B. Shadle (History); R. Shingles (Political Science); D. Tatar (Computer Science); G. Tilley-Lubbs (ESL & Multicultural Education); J. Watson (Foreign Languages and Literatures)

**Assistant Professors:** E. Bauer (Foreign Language & Literatures); D. Cline (History); E. Grafsky (Human Development); P. Hoon (Political Science); C. Kaestle (Human Development); C. Lavin (ASPECT); E. Mazzolini (English); S. Ovink (Sociology); S. Paterson (Art and Art History); P. Rivera-Rideau (Sociology); P. Seniors (Africana Studies); R. Scott (Religion & Culture); A. Sharma (Industrial Design); V. Venhatesh (Foreign Language & Literatures); N. Zhange (Foreign Language and Literatures)

**Professional Faculty:** E. Chancey (Religion & Culture); M. E. Christie (Women in International Development); S. Elber (Science & Technology); J. Henderson (Religion & Culture); M. James-Deramo (Service Learning); K. Precoda (Theatre & Cinema); L. Pendleton (Electrical and Computer Engineering); L. Wheeler (Psychology)

The field of Women's and Gender Studies (WGS) transforms traditional disciplines through new methods and theories generated by feminist scholarship. The Women's and Gender Studies Program is housed in the Department of Sociology and includes teaching faculty and affiliates from across the entire campus. WGS affiliated faculty contribute to the program through their research, student advising, participation in governance, and teaching.

Women's and Gender Studies offers courses for all students in the university, including four in Area 2 of the Curriculum for Liberal Education (WGS 1824, WGS 2224, WGS 2244, and WGS 2254), one in Area 3 (WGS 2264), and one in Area 7 (WGS 3214). Students interested in WGS may select from two minors, Women's and Gender Studies, and Gender, Science, and Technology. The degree option and minors are interdisciplinary, cross-cultural programs of study in which students cultivate an understanding of the complex ways that gender is defined and contested in social structures, history, culture, and technology.

They offer students new ways of thinking about how gender, race/ethnicity, class, and sexuality shape social institutions and cultural beliefs as well as personal experiences and perceptions. Central to the mission of the Women's and Gender Studies Program is the empowerment of a diverse population of women within local, regional, national, and global contexts.

Students interested in learning more about the Women's & Gender Studies program should contact the program director, Katrina Powell at [wgs@vt.edu](mailto:wgs@vt.edu)

A graduate certificate in Women's and Gender Studies is also available. See the [Graduate Catalog](#).

## Center For Peace Studies and Violence Prevention

**Director:** James Hawdon

The Center for Peace Studies and Violence Prevention is a student-center, multi-disciplinary undertaking to promote research, education and outreach in the area of peace studies and violence prevention. Since its inception in 2008, the Center has adopted three thematic areas:

- The prevention of violence
- Peace studies
- The development of new leaders for this century

The Center is a hub for research and pedagogy on peace studies and violence prevention. Our multidisciplinary approach allows students, faculty, and a variety of off-campus constituents to address peace building and violence prevention in a holistic manner.

The Center for Peace Studies offers a minor in Peace Studies. The minor is designed to provide students with a broad perspective on violence prevention and peace building. Students minoring in Peace Studies will be required to take three core courses, Peace and Violence as Critical Incidents (PSVP 2004), Peace Economics (AAEC 1264) and Global Society, Violence and the Prospects for Peace (PSVP 4104). In addition, students will select three elective courses from a variety of courses that focus on either "local" issues of violence prevention and peace building or "global" issues of violence prevention and peace building.

## Center for Race & Social Policy

**Director:** Wornie Reed

The Center for Race and Social Policy (RSP), presently a College Center, was formed in April 2001 as a University Center to fulfill two primary goals: (1) to conduct and disseminate original research in the area of public policy with a direct emphasis on race and ethnicity; and (2) to prepare promising graduate students to think and speak critically, plan quality research, and contribute to public-policy discussions related to race and ethnicity.

The Center promotes a broad and inclusive concept of race and ethnicity, which includes African Americans, American Indians, Asian Americans, European Americans, Latinos, and bi-racial and multi-racial identities. RSP research projects involve the development and evaluation of public policy across different racial and ethnic contexts and within myriad public policy venues, including welfare, employment, education, and health as well as community outreach.

## Undergraduate Course Descriptions (AFST)

### 1714: INTRODUCTION TO AFRICAN AMERICAN STUDIES

Introduction to the interdisciplinary field of Africana Studies. Organized around central themes and forces that have shaped and been shaped by the life experience of people of African descent. (3H,3C)

### 1814: INTRODUCTION TO AFRICAN STUDIES



Introduces students to the study of sub-Saharan Africa -- history, politics, economics, arts, and culture -- and to Africa's place in the world. Required first course in the African (Area) Studies concentration. (3H,3C)

**2144 (RLCL 2144): AFRICAN RELIGIONS**

The role of religious (or belief) systems in African society, especially the three predominantly religious traditions in Africa: the so-called African traditional religions, Islam, & Christianity; the universe of religious systems and religious experiences and processes of Africa, in particular Sub-Saharan Africa; critical examination of the mythic stature of Africa's "religions" within Western cultural (and scholarly) world views and institutions. (3H,3C)

**2204 (RLCL 2204) (WGS 2204): RACE AND GENDER IN RELIGION AND CULTURE**

Introduction to how race and gender influence and are influenced by religion and culture. Overview of approaches to categories of diversity, particularly race and gender, in religious and cultural traditions. Utilization of humanistic and social scientific approaches to investigate geographically variable historical and/ or contemporary case studies. (3H,3C)

**2264 (SOC 2264) (WGS 2264): RACE, CLASS, GENDER, AND SEXUALITIES**

Focuses on how race, class, gender, and sexualities form interlocking systems of privilege and oppression at individual and institutional levels. Emphasizes race, class, gender, and sexualities as changing social constructions and interactive systems that shape social institutions and organizations, meanings, and identities. Pre: WGS 1824. (3H,3C)

**2354 (SOC 2354): THE CIVIL RIGHTS MOVEMENT**

Examines the Civil Rights Movement in the U.S. Both non-violent and violent resistance will be examined, as well as strategies used in organizing mass boycotts, sit-ins, and marches. Special attention will be paid to how the movement shaped civil rights legislation on the federal level. The course also examines how the Movement influenced student protest on college campuses. (3H,3C)

**2454 (SOC 2454): RACE AND RACISM**

Examines theories of race and racism specifically as they relate to African Americans. We will explain conservative, neo-conservative, liberal, and progressive ideologies concerning race in past and recent United States contexts and how such theories emerged and continue to emerge in recent times. Though the majority of the course focuses on race and racism within the U.S., comparative analyses will be made with Brazil and South Africa. (3H,3C)

**2734 (SOC 2734) (WGS 2734): THE BLACK WOMAN IN THE U.S.**

The emerging womanist perspective of "interstructured oppression," (i.e., the simultaneous effects of racism, sexism, and classism) as relevant to the contributions of Black women in the U.S.; views of Black women from African backgrounds, the Atlantic slave trade, and the progressive rise of womanist/feminist liberation movements in Black culture; contributions of Black women in the U.S. and globally. (3H,3C)

**2754 (SOC 2754): SPORTS AND THE AFRO-AMERICAN EXPERIENCE**

Sports as a paradigm of the African-American experience. The forms of racism and the periodic significant social advances of the African-American community in the U.S. will be examined from the vantage point of African-American sports. Attention will also be paid to the continuing impact of sports on African-American culture. Sports heroes, successful teams and annual sporting events will be noted and analyzed. (3H,3C)

**2774: BLACK AESTHETICS**

A definition of those qualities of black American arts which distinguish it from traditional U.S. arts through an analysis of theme, form, and technique as they appear in a representative sample of works by black creative artists. (3H,3C)

**2974: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

#### 3174 (HIST 3174): AFRICAN AMERICAN MEN IN UNITED STATES HISTORY

Chronological and thematic examination of significant historical moments in black men's lives.

Examination of the social, cultural, and political forces contributing to a uniquely African American male experience in the United States. Survey of events in America's collective past such as wars, depressions, and protest movements. (3H,3C)

#### 3175,3176 (HIST 3175, 3176): AFRO-AMERICAN HISTORY

The Afro-American experience in the United States from 1619 to the present. Emphasis upon slavery and the strategies of economic and social survival in the twentieth century. 3175: 1619-1877 3176: 1877-present (3H,3C)

#### 3444 (CINE 3444) (SOC 3444): AFRICAN AMERICAN IMAGES IN FILM

Explores race and representations of African American images in film, from multiple disciplinary perspectives. Focuses on the social, political, economic, and historical milieu in which black film emerged and evolved. Examines gender issues in filmmaking. Reviews different genres, including race films, colorblind representations, and black exploitation films, and the appropriation of black representation and black images in film in the United States and elsewhere. Includes methods of film analysis, such as historical, master narrative structure, and archival research. Pre: 1714. (3H,3C)

#### 3454 (SOC 3454): AFRICAN AMERICAN LEADERSHIP FOR SOCIAL CHANGE

This course will utilize the three major paradigmatic assumptions in Black Studies (centeredness, critical analysis, and empowerment) to examine historical and contemporary African American leadership concepts and styles and their impact on social change. (3H,3C)

#### 3634 (ENGL 3634): AFRICAN AMERICAN LITERATURE

Afro-American writings from Phyllis Wheatley through the slave narratives of the nineteenth century to such modern figures as Wright, Hughes, Baldwin, and Morrison. (3H,3C)

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4354: TOPICS IN AFRICANA STUDIES

A variable topics course examining the lives and circumstances of people of African descent. Students may repeat the course with a different topic for up to 6 credits. Pre: Junior Standing. (3H,3C)

#### 4704: HISTORY OF AFRICAN-AMERICAN THEATRE

An in-depth study of Black Theatre in America. It will explore the history and development of Black Theatre - both commercial and non-commercial. The course will also stimulate critical thinking pertaining to racial issues, differences in aesthetics and cultures. Pre: 1714. (3H,3C)

#### 4754: INTERNSHIP

Variable credit course.

#### 4774: BLACKS IN THE PERFORMING ARTS

An examination of the performing arts as a paradigm of the African-American experience. Forms of U.S. racism and the periodic significant social advances of the U.S.'s African-American community will be examined in this course from the vantage points of blacks in theatre, film, dance, and music. Emphasis will be placed on the continuing impact of performing arts on African-American culture. Performers, heroes, historical works and performing arts events will be analyzed. Pre: 1714. (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (AINS)

1104: INTRODUCTION TO AMERICAN INDIAN STUDIES

Introduces students to the richness and complexity of American Indian societies past and present. The course begins by considering the critical question of what it means to be "American Indian" or "Native American," comparing externally produced stereotypes with a wide variety of indigenous discourses and narratives. Through a special focus on specific indigenous groups and regions, the course examines American Indian experiences with and reactions to colonial confrontations, government policies, and cultural interchanges with non-Indians. (3H,3C)

2104 (COMM 2104) (HUM 2104): ORAL TRADITIONS AND CULTURE

Examination of the world's great oral traditions, both ancient and contemporary. Emphasis on performance contexts, relationships among multicultural traditions, including American Indian oral traditions, and the relationships among orality, literacy, technology, media, and culture. (3H,3C)

2804 (ENGL 2804): CONTEMPORARY NATIVE AMERICAN LITERATURES

This course offers a sampling of fiction, poetry, and non-fiction by the most influential American Indian writers since 1970, authors such as Momaday, Silko, Deloria, Welch, Harjo, and Alexie. Students will also learn about those aspects of cosmology and storytelling traditionally shared by all American Indian Nations, as well as about those aspects specific to the individual tribal traditions from which the authors and their characters come. Pre: ENGL 1106 or ENGL H1204 or COMM 1016. (3H,3C)

2974: INDEPENDENT STUDY

Variable credit course.

3304 (ENGL 3304): THE LANGUAGES OF NATIVE AMERICA

Study of the structures of the native languages of the Americas; their interrelationships; their use in individual speech communities; contact with other languages; the interrelationships of linguistic structure, culture, and thought; their future survival. Pre: ENGL 1106 or ENGL H1204 or COMM 1016. (3H,3C)

3684 (PSCI 3684): INDIGENOUS PEOPLES AND WORLD POLITICS

A survey of the historical and contemporary struggles of indigenous peoples throughout the world. Examines the dynamics of colonialism (internal and external), identity construction, gender, cultural integrity, and the ongoing global indigenous rights discourse. In addition to covering broad global processes/theoretical approaches, comparative case studies of particular indigenous groups, such as the Maasai (Kenya, Tanzania) and Mayans (Mexico, Guatemala, Belize), are used to highlight the global, regional, and intra-community diversity among contemporary indigenous peoples. (3H,3C)

4004: TOPICS IN AMERICAN INDIAN STUDIES

A variable topics course in which students will engage an interdisciplinary methodology to pursue a critical and in-depth examination of various topics concerning and pertinent to American indigenous peoples. This course is repeatable for up to 6 hours credit with different topics. Must meet prerequisite or have permission of the instructor. Pre: 1104. (3H,3C)

4754: INTERNSHIP

Variable credit course.

4964: FIELD STUDY

Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (CRIM)

2974: INDEPENDENT STUDY

Variable credit course.

2984: SPECIAL STUDY

Variable credit course.

3414 (SOC 3414): CRIMINOLOGY

Principles of criminology and contemporary theories of criminal behavior, focusing on the extent and distribution of crime in the United States. Pre: SOC 1004. (3H,3C)

3434: SYSTEMS OF JUSTICE

Analyzes the systems of justice in the United States, from a sociological perspective. Focuses on law enforcement, courts, and corrections. Evaluates the effectiveness of social policies related to systems of justice. Explores the structural, community, and individual level factors that influence different stages of justice systems. Pre: 3414 or SOC 3414. (3H,3C)

3474: WOMEN AND CRIME

Focuses on women as victims and perpetrators of crime, with particular attention to race and class. Analyzes how social, cultural, and economic factors influence victimization and participation in crime. Includes adolescent girls' involvement with crime, including juvenile gangs. Evaluates theoretical explanations of why women commit crime. Examines women's experiences with the criminal justice system. Pre: 3414 or SOC 3414. (3H,3C)

4424 (SOC 4424): JUVENILE DELINQUENCY

Examination of juvenile delinquency. Includes methods of data collection and the extent and distribution of delinquency. Detailed coverage of theories of delinquent behavior. Examines the juvenile justice system and treatment and prevention of delinquency. Utilizes current empirical research on delinquency in the U.S. and internationally. Pre: SOC 3414 or CRIM 3414. (3H,3C)

4434 (SOC 4434): ADVANCED TOPICS IN CRIMINOLOGY

A variable topics course that focuses on topics related to criminology. In-depth examination of topics such as the death penalty, racial profiling, terrorism, white collar crime, law enforcement, international gangs, political crime, the prison system, cyber crime, and rape. No limit on the number of times taken if different topics. Pre: SOC 3414 or CRIM 3414. (3H,3C)

4754: INTERNSHIP

Variable credit course.

4964: FIELD STUDY

Variable credit course.

4974: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH  
Variable credit course.

## Undergraduate Course Descriptions (PSVP)

### 2044 (SOC 2044): PEACE AND VIOLENCE

Introduces major theories of peace and violence. Explores the root cause of interpersonal, institutional, and structural violence. Particular attention to conflict management, prevention strategies, and the promotion of peace at the local, national, and global levels. (3H,3C)

### 2984: SPECIAL STUDY

Variable credit course.

### 3854 (SOC 3854): GLOBALIZATION SOC. PERSPECTIVE

Distinguishes global from international. Examines social globalization and cultural globalization and what forms they take. Explores changes in the role of nation-states and the implications of global changes in the division of labor for economic, gender, and racial/ethnic inequalities. Discusses how globalization is linked with peace, violence, and human rights. Considers alternative and more equitable forms of globalizations and how social movements might lead to such alternatives. (3H,3C)

### 4104: GLOBAL SOCIETY, VIOLENCE AND THE PROSPECTS FOR PEACE

Examines major theories in the interdisciplinary field of peace studies. Includes current, historical, and global causes, patterns and types of conflict, and methods of conflict resolution. Particular attention given to the philosophical and sociological discussions of the causes of violence and the possibilities for peace. Pre: 2044 or SOC 2044. (3H,3C)

### 4444 (SOC 4444): SCHOOLS, VIOLENCE, AND JUSTICE

Focuses on the nature, extent, causes, and consequences of widely recognized forms of violence within schools, such as bullying, fighting, sexual assaults, harassment, dating violence, and shootings. Examines the effectiveness of violence prevention programs. Includes sociological theories of violence within schools. Explores the social debate over balancing the collective public safety obligations of schools with individual students' rights/responsibilities. Pre: SOC 3414. (3H,3C)

### 4974: INDEPENDENT STUDY

Variable credit course.

### 4984: SPECIAL STUDY

Variable credit course.

### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (SOC)

### 1004: INTRODUCTORY SOCIOLOGY

Social bases of human behavior, including an introduction to basic theories, research methods, social institutions, complex organizations, and human groups. Social and social psychological antecedents for politics, family, work, science, education, and religion. (3H,3C)

### 1014: INTRODUCTION TO SOCIAL ANTHROPOLOGY

Introduction to basic concepts in social anthropology related to the study of the evolution, social organization, and major institutions of traditional societies with emphasis on non-western cultures. (3H,3C)

### 1024: FIRST YEAR EXPERIENCE IN SOCIOLOGY

Develop an identity as a sociologist and foster a sense of community with first year and transfer students in the department. Acquire research skills and an awareness of university resources that enhance

academic success. Explore theories used and topics examined by sociologists and participate in sociological research. Identify careers and internship opportunities in sociology. (1H,1C)

#### 2004: SOCIAL PROBLEMS

Examines the nature, extent, and causes of social problems in the United States and around the globe from multiple perspectives. Emphasizes the role of conflicting economics, racial, ethnic, national, and gender interests in the creation and perpetuation of social problems. (3H,3C)

#### 2014: DATING, MARRIAGE AND DIVORCE

Description and analysis of dating and marital relationships in contemporary society, with additional attention given to factors associated with divorce. (3H,3C)

#### 2024: MINORITY GROUP RELATIONS

Reasons for existence of minority groups and consequences of being subordinate. Focus on racial, ethnic, gender, and age differences. Employment, family relations, health, and general quality of life. Includes cross-national comparisons. Core Curriculum approved for Area II only when taken only in combination with AFST 1714. (3H,3C)

#### 2034: DIVERSITY AND COMMUNITY ENGAGEMENT

Examines how understanding the patterns, meanings, and value of human diversity can improve social interactions within a diverse, global society. Focuses on issues of social justice, community, power, and privilege, using comparative, interdisciplinary, cross-cultural, and sociological perspectives. Explores social and cultural influences on people's identities and the implications for social relationships. With a collective responsibility to serve and improve the lives of others in a diverse society, students participate in community engagement projects. (3H,3C)

#### 2044 (PSVP 2044): PEACE AND VIOLENCE

Introduces major theories of peace and violence. Explores the root causes of interpersonal, institutional, and structural violence. Particular attention to conflict management, prevention strategies, and the promotion of peace at the local, national, and global levels. (3H,3C)

#### 2054 (RLCL 2054): ETHNOGRAPHY: STUDYING CULTURE

Introduction to the methodological tools used by anthropologists and other social scientists to study culture. Engagement with the development of, and debates about, ethnographic methods, as well as their application to case studies. Focus on analyses of sample ethnographic accounts of peoples throughout the world, as well as research techniques applicable to many different cultural environments. (3H,3C)

#### 2254 (WGS 2254): FEMINIST ACTVISM

Explores the history of individual and collective action geared toward gaining women's rights and improving women's positions in society. Course covers tensions and shifts in feminist movements, as well as the perspectives, agendas, and actions of specific subgroups of women whose perspectives sometimes conflict. Service-learning is a required component of the course. Pre: WGS 1824. (3H,3C)

#### 2264 (AFST 2264) (WGS 2264): RACE, CLASS, GENDER, AND SEXUALITIES

Focuses on how race, class, gender, and sexualities form interlocking systems of privilege and oppression at individual and institutional levels. Emphasizes race, class, gender, and sexualities as changing social constructions and interactive systems that shape social institutions and organizations, meanings, and identities. Pre: WGS 1824. (3H,3C)

#### 2274 (WGS 2274): WOMEN IN THE MILITARY

This course covers historical and global perspectives on the experiences women have had in and with the military. This course introduces students to issues concerning women fighters and military families, as well as to debates over women in combat positions, military policies, and globalization. (3H,3C)

#### 2284 (WGS 2284): LESBIAN, GAY, BISEXUAL, TRANSGENDER, AND QUEER ISSUES

Introduces students to Lesbian, Gay, Bisexual, Transgender, and Queer (LGBTQ) Studies, Focuses on sexuality and gender as historical and cultural constructs. Examines the experiences of individuals who do not conform to binary sex-gender systems and the development of diverse identities and LGBTQ communities. Introduces feminist and queer theories that address LGBTQ issues within social, political,

legal, and cultural institutions. Examines the institutional oppression of sexual minorities and implications of the intersectionalities of such systems of inequality as gender, race, ethnicity, class, age, and (dis)ability. Pre: WGS 1824 or permission of instructor. Pre: WGS 1824. (3H,3C)

#### 2304: INDIVIDUAL IN SOCIETY

Development of the self through social interaction. Factors affecting individual and collective perceptions, attitudes, and behavior in social contexts. (3H,3C)

#### 2354 (AFST 2354): THE CIVIL RIGHT MOVEMENT

Examines the Civil Rights Movement in the US. Both non-violent and violent resistance will be examined, as well as strategies used in organizing mass boycotts, sit-ins, and marches. Special attention will be paid to how the movement shaped civil rights legislation on the federal level. The course also examines how the Movement influenced student protest on college campuses. (3H,3C)

#### 2404: DEVIANT BEHAVIOR

Examines behaviors considered deviant in the United States. Explores major types of deviant behavior, such as corporate crimes, extremist groups, sexual deviance, violence, suicide, alcoholism and other drug addictions, and cyber deviance. Includes sociological theories that explain them. (3H,3C)

#### 2454 (AFST 2454): RACE AND RACISM

Examines theories of race and racism specifically as they relate to African Americans. We will explain conservative, neo-conservative, liberal, and progressive ideologies concerning race in past and recent United States contexts and how such theories emerged and continue to emerge in recent times. Though the majority of the course focuses on race and racism within the U.S comparative analyses will be made with Brazil and South Africa. (3H,3C)

#### 2514 (RLCL 2514): ASIAN AMERICAN EXPERIENCE

Critical overview of diverse Asian-American experience the complexity of minority status, and meaningful citizenship in the USA. Topics include different historical tracks of various Asian ethnicities, experiences of racism, activism, cultural adaptation and conflict, and economic survival and success. (3H,3C)

#### 2734 (AFST 2734) (WGS 2734): THE BLACK WOMAN IN THE U.S

The emerging womanist perspective of "interstructured oppression," (i.e., the simultaneous effects of racism, sexism, and classism) as relevant to the contributions of Black women in the U.S.; views of Black women from African backgrounds, the Atlantic slave trade, and the progressive rise of womanist/feminist liberation movements in Black culture: contributions of Black women in the U.S. and globally. (3H,3C)

#### 2754 (AFST 2754): AFRO-AMERICAN SPORTS

Sports as a paradigm of the African-American experience. The forms of racism and the periodic significant social advances of the African-American community in the U.S will be examined from the vantage point of African-American sports. Attention will also be paid to the continuing impact of sports on African-American culture. Sports heroes, successful teams and annual sporting events will be noted and analyzed. (3H,3C)

#### 2964: FIELD STUDY

Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3004: SOCIAL INEQUALITY

Class, status, and power in society. Theories and empirical research findings on vertical and horizontal stratification in society. Class differences in behavior, values, and avenues and extent of social mobility.

Cross cultural comparisons. Pre: 1004. (3H,3C)

#### 3014: GENDER RELATIONS

Focus on the social construction of gender relations. Examines how gender relations vary cross-culturally, historically, and for different categories of men and women. Explores the causes and consequences of inequality and privilege. Attention paid to the ways race, ethnicity, class, age, and sexualities shape and are shaped by gender and the relationship of gender to social institutions. Pre: 1004. (3H,3C)

#### 3104: SOCIOLOGICAL THEORY

Focus on the development and contemporary state of sociological theory. Primary concern is with those theorists who have had significant impact on our thinking about the relationships among man, society, and nature. Pre: 1004. (3H,3C)

#### 3144 (ENGL 3144) (RLCL 3144): LANGUAGE AND ETHNICITY IN THE UNITED STATES

Exploration of how racial and ethnic identity are expressed through the use of different languages and dialects. Examination of how language is related to issues of equality, social opportunity, and discrimination in the United States. Pre: ENGL 1106 or ENGL 1204H or COMM 1016. (3H,3C)

#### 3204: SOCIAL RESEARCH METHODS

Techniques of data collection and analysis employed in the social sciences with emphasis on survey research methods including questionnaire construction, sampling, and analysis of both self-collected and national data; logic behind application of these techniques. Pre: 1004. (4H,4C)

#### 3303: SOCIAL MOVEMENTS

Examines the definitions, emergence, operations, and impact of social movements. Focuses on key social movements such as the civil rights, women's, peace and human rights, labor, and global justice movements. Pre: 1004. (3H,3C)

#### 3304: COLLECTIVE ACTION

How people organize to influence institutional arrangements in society. Panic behavior, riots, protest movements, strikes, coalitions, and revolutions. Theories and issues related to collective action. Pre: 1004. (3H,3C)

#### 3324 (STS 3324) (WGS 3324): PERSPECTIVES ON THE BIOLOGY OF WOMEN

Examines historical social and cultural views on women's biology and how those views have impacted women's physical and mental health. Special attention is paid to the influence of cultural and beliefs on scientific perspectives. Pre: WGS 1824. (3H,3C)

#### 3414 (CRIM 3414): CRIMINOLOGY

Principles of criminology and contemporary theories of criminal behavior, focusing on the extent and distribution of crime in the United States. Pre: 1004. (3H,3C)

#### 3444 (AFST 3444) (CINE 3444): AFRICAN AMERICAN IMAGES IN FILM

Explores race and representation of African American images in film, from multiple disciplinary perspectives. Focuses on the social, political, economic, and historical milieu in which black film emerged and evolved. Examines gender films issues in filmmaking. Reviews different genres, including race films, colorblind representations, and black exploitation films, and the appropriation of black representation and black images in film in the United States and elsewhere. Includes methods of film analysis, such as historical, master narrative structure, and archival research. Pre: AFST 1714. (3H,3C)

#### 3454 (AFST 3454): AFRICAN AMER LDRSHIP FOR CHNG

This course will utilize the three major paradigmatic assumptions in Black Studies (centeredness, critical analysis, and empowerment) to examine historical and contemporary African American leadership concepts and styles and their impact on social change. (3H,3C)

#### 3464 (AHRM 3464) (APS 3464) (GEOG 3464) (HD 3464) (HUM 3464) (UAP 3464): APPALACHIAN COMMUNITIES

The concept of community in Appalachia using an interdisciplinary approach and experiential learning. Interrelationships among geographically, culturally, and socially constituted communities, public policy,



and human development. Pre: Junior standing. (3H,3C)

#### 3504: POPULATION TRENDS AND ISSUES

Contemporary American and global population trends in historical and comparative perspective. Discussion of the impact of population change on individual and society. Relevant public policy questions examined. Pre: 1004. (3H,3C)

#### 3614: GENDER AND WORK IN THE U.S.

Examination of the role that gender plays in shaping the experience of work, focusing especially on the persistence of occupational segregation by sex, its causes and implications. Also, the interaction of work and family life, including the allocation of household work and control of resources. Social policies affecting gender relations in work organizations will be analyzed. Pre: 1004. (3H,3C)

#### 3714: SOCIOLOGY OF AGING

Emergence of old age as a social problem. Social aspects of aging in America, including the minority experience and with some cross-cultural comparisons. Social and demographic characteristics of the aged, location of aged in the social structure, and current and future social problems of old age. Pre: 1004. (3H,3C)

#### 3854 (PSVP 3854): GLOBALIZATION: SOCIOLOGICAL PERSPECTIVES

Distinguishes global from international. Examines social globalization and cultural globalization and what forms they take. Explores changes in the role of nation-states and the implications of global changes in the division of labor for economic, gender, and racial/ethnic inequalities. Discusses how globalization is linked with peace, violence, and human rights. Considers alternative and more equitable forms of globalizations and how social movements might lead to such alternatives. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 4014: SOCIOLOGY OF THE FAMILY

The family as a basic social institution: similarities and variations in family systems, their interrelationships with other social institutions, and patterns of continuity and change. Taught alternate years. Pre: 2014. (3H,3C)

#### 4024 (RLCL 4024): SOCIOLOGY OF RELIGION

Religion as a social structure as well as an institution; with special attention to the functions of religion for individuals, groups and societies, social organization; and the interplay between religion and other social institutions including economics and polity. Taught alternate years. Pre: 1004. (3H,3C)

#### 4034: SOCIOLOGY OF EDUCATION

Analysis of the structure, functions, and consequences of schooling in America, the social processes affecting academic achievement, and the implications of current knowledge for educational reform. Taught alternate years. Pre: 1004. (3H,3C)

#### 4044: MILITARY SOCIOLOGY

The military institution and its relationship to society. Emphasis on the role of the military and its social organization; recruitment, socialization, career, combat, deviant behavior, changes in the military, and future trends. Taught alternate years. Junior standing. Pre: 1004. (3H,3C)

#### 4054 (APS 4034): APPALACHIAN LANGUAGES AND CULTURES

An empirical examination of how Appalachian speech both reflects and constitutes regional cultures. Emphasis is on applying sociological and anthropological methods and theories to the study of language in use. (3H,3C)

#### 4094 (APS 4094): APPALACHIAN COMMUNITY RESEARCH

Undergraduate participatory community research as applied to issues of cultural heritage, sustainability,

and identity. Students engage in projects defined by community groups and organizations as being critical to their well-being, continuity, or growth. Emphasis is on developing concepts of civic professionalism and developmental democracy. (3H,3C)

#### 4114: THE SOCIOLOGY OF POPULAR MUSIC

Examine the social context(s) of popular music, including the social, economic, and political factors that influence the development of different popular music forms; authenticity within popular music genres; popular music's impact on social activity and identity; the institutions that connect popular music producers with consumers. Pre: 1004, 1014 or AFST 1714. (3H,3C)

#### 4124 (RLCL 4124) (WGS 4124): TOPICS IN CULTURE

Uses sociological, anthropological, as well as artistic and humanist paradigms to analyze culture. Discusses 20th and 21st century cultural trends. Analyzes the implications of social context for cultural artifacts such as art. Topics are variable. Example topics include the cultural construction of race and the cultural of the nineteen sixties. Course may be repeated with different course content for up to 6 credits. Junior or Senior standing. Pre: 1004 or 1014 or AFST 1714 or AINS 1104 or RLCL 1004 or RLCL 2004 or WGS 1824. (3H,3C)

#### 4194: SENIOR SEMINAR

Required seminar for majors. Integration and application of prior coursework, including reviews of theory and research methods. Application of sociological knowledge toward an actual needs assessment in a work setting, completion of a social policy analysis, and a written critique of a sociological publication. Course serves as a bridge to graduate study, prepares students for application of sociological knowledge, and provides overall career guidance. Senior standing and sociology majors only. Pre: 3104, 3204. (3H,3C)

#### 4204: APPLIED RESEARCH

Stresses differences between applied research and other methodologies. Examines the topics, purposes, problems, theories, and methods appropriate for applied research. Explores ethical and political issues prevalent in applied settings. Includes qualitative, quantitative, and mixed methodologies. Emphasis on survey construction and administration, experimental designs, evaluation research, and participatory action research as used by applied researchers. Includes data analysis and issues of presenting applied research to lay audiences. Pre: 3204, STAT 3604. (3H,3C)

#### 4294: CAPSTONE: DIVERSITY ENGAGEMENT

In-depth examination of core themes of diversity. Explains patterns and relational/intersectional aspects of diversity, including the history and legacies of inclusion and exclusion, from a variety of perspectives. Synthesizes diverse writings on issues of social justice and community, power and privilege. Uses social science theories and concepts of diversity to examine contemporary issues of diversity and to facilitate and interpret community engagement projects based in students' major fields of study. Focuses on collective responsibility to eliminate bias and discrimination through students' community-based project outcomes. This course is restricted to students who have enrolled in the Diversity and Community Engagement Minor. Pre: 2034. (3H,3C)

#### 4304: RESEARCH METHODS TOPICS

Variable topics course that focuses on different research methodologies. Includes topics such as feminist research, qualitative methodologies, survey design, evaluation research, and anthropological methods. Can be taken multiple times if different topic. Pre: 3204, STAT 3604. (3H,3C)

#### 4334 (STS 4334) (WGS 4334): SEXUAL MEDICINE

Discusses sex and medicine in contemporary U.S. society. Explores how notions of sexual behavior and "normality" are defined and structured by medical discourse. Examines cultural institutions that play significant roles in formulating ideas about and definitions of deviance, perversity, and tolerated marginality. Critiques medical responses to sexual variations. Examines experiences of people who have sought out, have been the unwilling victims of, sexual medicine. Junior standing required. Pre: WGS 1824. (3H,3C)

#### 4404: SOCIOLOGY OF LAW

The functions of law as a form of social control. The social forces in the creation, enforcement, and change of the law. The nature of law as a force in social change. Taught alternate years. Pre: 1004. (3H,3C)

#### 4414: DRUGS AND SOCIETY

Examines the use of drugs, including legal and illegal drugs, from a sociological perspective. Cross-cultural and historical patterns of use are discussed and explained. Particular attention is given to drug use within the context of various social institutions. Junior standing. Pre: 1004. (3H,3C)

#### 4424 (CRIM 4424): JUVENILE DELINQUENCY

Examination of juvenile delinquency. Includes methods of data collection and the extent and distribution of delinquency. Detailed coverage of theories of delinquent behavior. Examines the juvenile justice system and treatment and prevention of delinquency. Utilizes current empirical research on delinquency in the U.S. and internationally. Pre: 3414 or CRIM 3414. (3H,3C)

#### 4434 (CRIM 4434): ADVANCED TOPICS IN CRIMINOLOGY

A variable topics course that focuses on topics related to criminology. In-depth examination of topics such as the death penalty, racial profiling, terrorism, white collar crime, law enforcement, international gangs, political crime, the prison system, cyber crime, and rape. No limit on the number of times taken if different topics. Pre: 3414 or CRIM 3414. (3H,3C)

#### 4444 (PSVP 4444): SCHOOLS, VIOLENCE, AND JUSTICE

Focuses on the nature, extent, causes, and consequences of widely recognized forms of violence within schools, such as bullying, fighting, sexual assaults, harassment, dating violence, and shootings. Examines the effectiveness of violence prevention programs. Includes sociological theories of violence within schools. Explores the social debate over balancing the collective public safety obligations of schools with individual students' rights/responsibilities. Pre: 3414. (3H,3C)

#### 4704: MEDICAL SOCIOLOGY

Social and cultural response to illness and infirmity. Emphasis on the sick role, patient role, practitioner role, organization and politics of health care delivery, stratification, professionalism, and socialization of health practitioners. Taught alternate years. Junior Standing. Pre: 1004. (3H,3C)

#### 4714: SOCIOLOGY OF MENTAL ILLNESS

Mental illness and social systems, historically and in contemporary society. Distribution of mental illness with special reference to stratification, role, and deviance theories. Mental health occupations and organization of treatment. Implications for social policy. Taught alternate years. Junior standing. Pre: 1004. (3H,3C)

#### 4754: INTERNSHIP

Placement and sociologically relevant work in one of a variety of human service settings, combined with relevant readings, discussion and written work coordinated jointly by a faculty member and the setting supervisor. Placement settings include human resource agencies, corrections facilities, extension offices, and law agencies. Sociology major or minor required. Junior or Senior standing required. Consent of internship coordinator required. Coursework relevant to placement setting. Variable credit course.

#### 4764 (GEOG 4764) (UAP 4764): INTERNATIONAL DEVELOPMENT POLICY AND PLANNING

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. Junior standing required. (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course. X-grade allowed.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.

## Undergraduate Course Descriptions (WGS)

#### 1824: INTRODUCTION TO WOMEN'S AND GENDER STUDIES

This interdisciplinary introduction to Women's and Gender Studies examines interrelations between men and women as social groups in the contexts of race, class and other systems of inequality. It places special focus on the diverse experiences of women and feminist struggles for social change. (3H,3C)

#### 2114: FEMINIST THEORY

Examination of diverse theoretical perspectives on women and gender, including their historical origins and political implications. Special emphasis on integrative perspectives that also address race, class, and other dimensions of inequality. Pre: 1824. (3H,3C)

#### 2204 (AFST 2204) (RLCL 2204): RACE AND GENDER IN RELIGION AND CULTURE

Introduction to how race and gender influence and are influenced by religion and culture. Overview of approaches to categories of diversity, particularly race and gender, in religious and cultural traditions. Utilization of humanistic and social scientific approaches to investigate geographically variable historical and/ or contemporary case studies. (3H,3C)

#### 2224: WOMEN AND CREATIVITY

A study of the philosophical, artistic, and biographical dimensions of women's creativity in a wide variety of fields. Pre: 1824. (3H,3C)

#### 2244: WOMEN AND SCIENCE

Uses research from the disciplines of science, women's studies, history, sociology, and philosophy to examine women's roles in the fields of science, technology, engineering, and mathematics. Starting with historical figures, students will follow the progress women have made in entering and succeeding in science careers. Pre: 1824. (3H,3C)

#### 2254 (SOC 2254): FEMINIST ACTIVISM

Explores the history of individual and collective action geared toward gaining women's rights and improving women's positions in society. Course covers tensions and shifts in feminist movements, as well as the perspectives, agendas, and actions of specific subgroups of women whose perspectives sometimes conflict. Service-learning is a required component of the course. Pre: 1824. (3H,3C)

#### 2264 (AFST 2264) (SOC 2264): RACE, CLASS, GENDER, AND SEXUALITIES

Focuses on how race, class, gender, and sexualities form interlocking systems of privilege and oppression at individual and institutional levels. Emphasizes race, class, gender, and sexualities as changing social constructions and interactive systems that shape social institutions and organizations, meanings, and identities. Pre: 1824. (3H,3C)

#### 2274 (SOC 2274): WOMEN IN THE MILITARY

This course covers historical and global perspectives on the experiences women have had in and with the military. This course introduces students to issues concerning women fighters and military families, as well as to debates over women in combat positions, military policies, and globalization. (3H,3C)

#### 2284 (SOC 2284): LESBIAN, GAY, BISEXUAL, TRANSGENDER AND QUEER ISSUES

Introduces students to Lesbian, Gay, Bisexual, Transgender, and Queer (LGBTQ) Studies. Focuses on sexuality and gender as historical and cultural constructs. Examines the experiences of individuals who

do not conform to binary sex-gender systems and the development of diverse identities and LGBTQ communities. Introduces feminist and queer theories that address LGBTQ issues within social, political, legal, and cultural institutions. Examines the institutional oppression of sexual minorities and implications of the intersectionalities of such systems of inequality as gender, race, ethnicity, class, age, and (dis)ability. Pre: 1824 or permission of instructor. Pre: 1824. (3H,3C)

**2734 (AFST 2734) (SOC 2734): THE BLACK WOMAN IN THE U.S.**

The emerging womanist perspective of "interstructured oppression" (i.e., the simultaneous effects of racism, sexism, and classism) as relevant to the contributions of Black women in the United States of America; views of Black women from African backgrounds, the Atlantic slave trade, and the progressive rise of womanist/feminist liberation movements in Black culture; contributions of Black women in the U.S. and globally. (3H,3C)

**2974: INDEPENDENT STUDY**

Variable credit course.

**2984: SPECIAL STUDY**

Variable credit course.

**3004: TOPICS IN FEMINISM**

A variable topics course that addresses how the social construction of gender shapes social, cultural, political, economic, and institutional structures as well as individual experiences and perceptions. The course stresses interdisciplinary approaches to topics of emerging interest in feminist scholarship. Can be taken up to three times for credit with varying topic. In addition to WS 1824, must have taken a 2000-level Women's Studies course, or have instructor's consent. Pre: 1824. (3H,3C)

**3014 (RLCL 3014): WOMEN AND GENDER IN ISLAM**

An examination of women and gender in Islam from a variety of perspectives including Muslim women in Islamic history, normative constructions of the roles of women in Islam, and women's role in contemporary Muslim societies. Understanding of women in classical Islam; feminist and reformist approaches; and Western constructions of the "rights of women in Islam." Pre: RLCL 2324. (3H,3C)

**3134 (ENGL 3134): GENDER AND LINGUISTICS**

Exploration of differences--real and imagined--in the speech of men and women. Examination of how language can reflect and reinforce gender inequality. Linguistic phenomena covered: pitch, vocabulary, sound change, language ideologies, and discourse strategies and types. Pre: ENGL 1106 or ENGL 1204H or COMM 1016. (3H,3C)

**3214: GLOBAL FEMINISMS**

An introduction to the gendered analysis of global women's issues with a special focus on women of color. Examines the multiple and diverse sites of feminist struggle within the third world, and between first and third worlds both in the U.S. and internationally. Studies the impact on women of political movements such as nationalism, colonialism, revolution, authoritarianism and democracy. Compares theories originating with women of color in the U.S. with those from international third worlds. Pre: 2264. (3H,3C)

**3324 (SOC 3324) (STS 3324): PERSPECTIVES ON THE BIOLOGY OF WOMEN**

Examines historical, social, and cultural views of women's biology and how those views have impacted women's physical and mental health. Special attention is paid to the influence of cultural traditions and beliefs on scientific perspectives. Pre: 1824. (3H,3C)

**3984: SPECIAL STUDY**

Variable credit course.

**4124 (RLCL 4124) (SOC 4124): TOPICS IN CULTURE**

Uses sociological, anthropological, as well as artistic and humanist paradigms to analyze culture. Discusses 20th and 21st century cultural trends. Analyzes the implications of social context for cultural artifacts such as art. Topics are variable. Example topics include the cultural construction of race and the culture of the nineteen sixties. Course may be repeated with different course content for up to 6 credits. Junior or Senior standing. Pre: SOC 1004 or SOC 1014 or AFST 1714 or AINS 1104 or RLCL 1004 or

RLCL 2004 or WGS 1824. (3H,3C)

**4214 (GEOG 4214) (UAP 4214): WOMEN, ENVIRONMENT AND DEVELOPMENT IN A GLOBAL PERSPECTIVE**

Explores intersecting roles of gender, culture, and socio-economic status in people's use of nature, management of environmental resources, and experiences of environmental change. Examines debates on environmental and development initiatives, environmental ethics, and environmental social movements from feminist perspectives. Pre: Junior standing required. (3H,3C)

**4224: WOMEN'S STUDIES SEMINAR**

This multi-disciplinary, multi-cultural course examines a significant topic in Women's Studies, utilizing the perspectives of history, biology, psychology, political science, sociology, and the arts. Variable topics. Pre: 1824, 2114. (3H,3C)

**4334 (SOC 4334) (STS 4334): SEXUAL MEDICINE**

Discusses sex and medicine in contemporary U.S. society. Explores how notions of sexual behavior and "normality" are defined and structured by medical discourse. Examines cultural institutions that play significant roles in formulating ideas about and definitions of deviance, perversity, and tolerated marginality. Critiques medical responses to sexual variations. Examines experiences of people who have sought out, or been the unwilling victims of, sexual medicine. Junior standing required. Pre: 1824. (3H,3C)

**4704 (STS 4704): GENDER AND SCIENCE**

Investigates the gender dimensions of science in both historical and contemporary perspectives. Discusses feminist studies of science, exploring strengths and limitations. Assesses implications of cultural assumptions about gender for practicing scientists. A 3000 level course in science or engineering may satisfy prerequisite. Pre: 2244 or STS 1504. (3H,3C)

**4754: INTERNSHIP**

Qualified students will be placed with a community agency or on-campus office which addresses contemporary issues of gender, class, and/or race, and will meet periodically with an appropriate faculty member to discuss assigned readings that will provide a context for the work experience. Students will also be expected to keep a journal and to write up a final evaluation of the experience. Variable credit: may be taken for up to 6 elective credits in the Women's Studies concentration. Junior standing, screening interviews with Tech faculty and with the service agency and consent required. Variable credit course. Pre: 1824.

**4964: FIELD STUDY**

Pass/Fail only. Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## School of Visual Arts

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**Director:** Kevin Concannon

**Professors:** C. Burch-Brown, D.F. Crane, and L. B. Van Hook

**Associate Professors:** M. Casto, A.M. Knoblauch, M. Moseley-Christian, S. Paterson, E. Standley, T. Tucker, and D. Webster

**Assistant Professors:** S. Blanchard, M. Borowski, M. Dee, P. Finley, T. Head, J. Joiner, K. Meaney, and R. Weaver

**Instructors:** D. H. Bannan, J. Hand, J. Rosenthal, A. Salisbury, and D. Sim

**Armory Art Gallery Director:** D. Sim

**Associate Director of Academic Advising:** Tracey Proco Drowne

**Director of FourDesign:** J. Joiner

**Program Chairs:** Art and Art History - M. Moseley-Christian, Visual Communication Design - M. Dee, and Studio Arts - T. Head

**Area Coordinators:** Foundations of Art - E. Standley

Web: [www.sova.vt.edu](http://www.sova.vt.edu)

The School of Visual Arts (SOVA) offers studio-based programs in the visual arts balanced with the study of the history, theory, and criticism of visual and material culture. The faculty includes both practicing artists and scholars of art history. The School emphasizes new digital media as well as traditional artistic media. We offer B.F.A. degrees in both Visual Communication Design and Studio Arts, as well as a B.A. degree and minor in Art History.

SOVA provides a variety of exhibitions and art events. The Armory Art Gallery exhibits work by national and regional artists. XYZ, a student-run gallery, provides students and regional artists the opportunity to create and show wide-ranging experimental work. The Collaboration for Creative Technologies in Arts and Design (CCTAD) is a cross-disciplinary initiative with Art, Music, Computer Science and Communications. The Digital Arts and Animation Studio (DAAS) is designed to facilitate this new concentration.

FourDesign, a University Service Center, provides outstanding seniors with a vital professional design experience. Student interns work in a team environment under the direction of FourDesign faculty to produce design work for clients, providing professional and entrepreneurial experience rarely available to undergraduates. Through visiting artists and scholars, the School also brings students and members of the art community into dialogue with artists and critics of international prominence.

SOVA participates in the University's Education Abroad Program, which is open to students at the sophomore level or above, and combines classroom study with travel-study tours in Europe, Cuba, and Latin America.

Foundations of Art and Design is a year-long, entry-level intensive program that prepares students for advanced study in the visual fields of Integrative Studio Art and Visual Communications Design. The two-semester, 1000-level curriculum is made up of 15 credit hours covering principles of art and design, drawing, and digital Imaging proficiency. Completion of the entire Foundation Program is required of B.F.A. students prior to taking SOVA courses that are 2000 level or higher.

The investigation and unification of dexterity, contextual dialogue, and presentation skills are at the heart of the Foundations of Art and Design program at SOVA. Rather than isolating craft at the foundational level of study, whole elements of visual language are fostered equally. This unified approach to art and design studies aim to develop:

- Innovation and creative leadership skills
- Visual logic through multimedia
- Confidence with digital and analog crossover
- Traditional awareness applicable to contemporary tools of production

## Portfolio Review

Students must pass the annual Portfolio Review in order to enter the B.F.A. programs in Studio Art, Creative Technologies, or Visual Communications Design. The SOVA Foundations of Art and Design curriculum supplies students with the necessary information and proficiency to compete in Portfolio Review.

Studio Art, Creative Technologies, and Visual Communications Design candidates must be currently enrolled or have passed three foundation courses (ART1204 Principles of Art and Design, ART1404 Drawing 1 and ART1604 Principles of New Media). Acceptance is contingent on successfully passing all three of these courses. The Studio Art, Creative Technologies, and VCD Review Committees (comprised of SOVA Faculty) screen student work for outstanding qualities in artistic ability, creativity, presentation skills and overall motivation.

## Bachelor of Fine Arts in Studio Art

In the Studio Arts program, majors can choose their emphasis from a variety of disciplines including Painting, Drawing, Ceramics, Digital/Media and Sculpture. The studio curriculum encourages students to



explore and develop their talents and interests. While specialization in the traditional sense is open to all majors, the school also encourages innovative approaches by exploring areas in which different media and disciplines fruitfully overlap. The B.F.A. in Studio Arts is specially designed to prepare students who plan to continue their education as artists at the graduate level.

The Bachelor of Fine Arts degree in Studio Arts is a 78 credit-hour program. Each faculty member is dedicated to teaching, research, and outreach within his or her specific fields. The connection from professional practice to studio classroom is essential in creating applicable learning environments.

The goal of the program is to develop culture-enriching leaders and innovative visual artists. Completing an integrated path of study in the Studio Arts Program will result in a B.F.A. degree that is applicable to the demands of the visual arts industry.

## Bachelor of Fine Arts in Creative Technologies

The Bachelor of Fine Arts in Creative Technologies focuses on computer-based digital arts, including animation, creative coding, interactive installations, etc. Classes are taught by active artists and scholars with experience integrating emerging creative technologies into new media art contexts as well as applications in industry.

The Creative Technologies concentration consists of 75 credit hours, with 21 required credits and additional elective offerings that can be clustered so that students obtain specialization in any of the following areas : Immersive Virtual Environments, Code and Form or The Moving Image.

With a BFA in Creative Technologies, students learn cutting-edge software in a creative environment, preparing them for employment in industry or further studies in graduate school.

## Bachelor of Fine Arts in Visual Communication Design

The Visual Communication Design program is notable for its practical and applied approach to design pedagogy. Majors in Visual Communication Design develop conceptual abilities, problem solving skills and technical know-how required by a fast-paced, competitive field. Visual Communication Design demands individual creativity, teamwork skills, and adaptability to changing markets and technologies. The Visual Communication Design program at Virginia Tech prepares students for the job market with practical experience and a full, professional portfolio. Graduates of the program may find themselves working in print design, product and packaging design, multimedia web page design, and advertising design. Coursework in 3D Animation and Interactive Design allows students to explore emerging design technologies.

Visual Communication Design offers a Bachelor of Fine Arts degree (B.F.A.). Entry into this program is restricted and requires successful completion of specific criteria. See [Portfolio Review](#) above.

Students who have been accepted into the Visual Communication Design Program begin the Visual Communication Design course sequence in the spring semester. From that point on, the course sequences are uniquely tailored to Visual Communication Design students.

## Bachelor of Arts in Art History

The Art History Program develops the analytical and conceptual skills necessary for students to explore visual and material culture in its historical, social, cultural, political and theoretical contexts, over a range of periods and styles. Students are acquainted with research practices and the methodologies that are used to critically assess and write about art within the discipline. Art History faculty offers a variety of courses in ancient, early modern, 19th century, contemporary, and nonwestern visual and material culture, as well as special topics courses.

Students in the program may have opportunities to apply for various internships or volunteer positions in

the local and regional area, in order to expand on their academic experience in the classroom. An undergraduate concentration in Art History may lead to graduate studies and careers in teaching and research, while there are also numerous opportunities in museums, galleries, auction houses, archives, publishing companies and others.

Majors in the Art History B.A. program take 42 credit hours. An 18 credit minor in Art History is also offered. The minor in Art History is intended to give the student a foundation in visual literacy and an understanding of the historical, theoretical and critical approaches that are used to interpret the visual world. Because Art History is an academic program, there is no entry portfolio requirement.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Undergraduate Course Descriptions (ART)

### 1004: TOPICS IN STUDIO ART FOR NON-MAJORS

Variable introductory topics on practice-based studio art, ranging from 2D, 3D and Digital Imaging concentrations. Multiple projects with emphasis on media specific creations including historical and cultural understanding. Different topics may be repeatable for up to 12 credit hours. (1H,5L,3C)

### 1204: PRINCIPLES OF ART & DESIGN I

Introduction of two-dimensional principles of design through employment of traditional and digital media. Reference to historical and theoretical context strengthens proficiency in the language of design. Application of contemporary practices and ethics. Projects, applied problem solving, reading assignments and critiques supply graphic skills and specialized vocabulary. RESOURCE CHARGE. (1H,5L,3C)

### 1214: PRINCIPLES OF ART & DESIGN II

Introduction of two-dimensional principles of design through employment of traditional and digital media. Reference to historical and theoretical context strengthens proficiency in the language of design. Application of contemporary practices and ethics. Projects, applied problem solving, reading assignments and critiques supply graphic skills and specialized vocabulary. RESOURCE CHARGE. Pre: 1204, 1404. (1H,5L,3C)

### 1404: DRAWING I

Methods and concepts fundamental to drawing, for the beginning student. No previous experience necessary. Emphasis on controlled use of common drawing media for representational and expressive purposes. RESOURCE CHARGE. (1H,5L,3C)

### 1414: DRAWING II: LIFE DRAWING

Drawing the human figure from life. Emphasis on observation, construction, and anatomy. RESOURCE CHARGE. Pre: 1404, 1204, 1604. (1H,5L,3C)

### 1604: PRINCIPLES OF NEW MEDIA ART & DESIGN

Introduces the student to the concept of new media through the research and development of contemporary art and design. The creative and aesthetic potential of the computer will be explored to

produce new media product. RESOURCE CHARGE. (1H,5L,3C)

#### 1614: PRINCIPLES OF VISUAL COMMUNICATION DESIGN

Introduction to design theory, practice, and visual communication skills. Projects, applied problem solving, reading assignments, and open critiques incorporate graphic competencies and vocabulary specific to the field of visual communication design. Pre: 1204, 1404, 1604. (1H,5L,3C)

#### 2385,2386: SURVEY OF THE HISTORY OF WESTERN ART

Survey of art and architecture of Western Europe. 2385: emphasis on Greek, Roman, and medieval 2386: from ca. 1300 to the contemporary period; works of major masters such as Giotto, Leonardo, Michelangelo, Rembrandt, as well as works of European and American Impressionism, Expressionism, and Modernism. (3H,3C) 2385: I,III,IV; 2386:

#### 2524: INTRODUCTION TO PAINTING

Students will explore painting practices and their relationship to art and design in contemporary culture, and develop basic painting skills and an understanding of various painting media. Encompasses illustrational technique and practical applications, expressive and abstract approaches to painting. RESOURCE CHARGE. Pre: 1204, 1404, 1604. (1H,5L,3C)

#### 2544: CERAMICS I

Basic investigations into the materials, techniques, history and appreciation of the ceramic arts. Ceramic processes and technology including hand forming construction methods, glazing, and kiln firing. Design concepts as they relate to clay objects are stressed. Historic and contemporary ceramics objects along with methods and traditions of cultures from around the world will be introduced through a range of media. RESOURCE CHARGE. Pre: 1204, 1404, (1604 or 1504). (1H,5L,3C)

#### 2554: INTRODUCTION TO SCULPTURE

An introduction to sculptural processes and materials in art and design. Intensive studio work on individual projects. Review of historical and contemporary issues as applied to the definition of space, texture, mass, volume, scale and other principles of three-dimensional art. RESOURCE CHARGE. Pre: (1204, 1404), 1604. (1H,5L,3C)

#### 2565-2566: TYPOGRAPHY

Foundational study of Typography as it relates to Visual Communication Design including historical and contemporary context. Study of the formal principles of typographic design of both printed and digital matter. Overall focus on letterforms, design structures, and grid systems. Pre: Admittance to Visual Communication Design Program. 2566: Intermediate study of Typography as it relates to Visual Communication Design including advanced file management used with a variety of projects involving Typographic Composition. Pre: 2565. (1H,5L,3C)

#### 2575-2576: INTRODUCTION TO GRAPHIC DESIGN

Introduction to the theory and practice of graphic design as a means of visual communication, exploring problem-solving as applied to design concepts and execution. Studio assignments relating to society, industry, community, and commerce, with emphasis on digital/electronic applications. Resource charge. Pre: 1604, 1204, 1404 for 2575; 2575 for 2576. Co: 1414 for 2575. (1H,5L,3C)

#### 2604: INTRO TO NEW MEDIA ART

An introduction to digital time-based technologies to develop new media products including, stop-motion videos, 2D animations and interactive projects for delivery on the Internet. Aesthetic ideas and concepts of new media art will be examined. RESOURCE CHARGE Pre: 1604. (1H,5L,3C)

#### 2644: CERAMICS II

Introduction to forming methods using the potter's wheel. Design concepts, techniques and approaches to creating functional forms. Overview of contemporary and historic utilitarian ceramics. RESOURCE CHARGE. Pre: 2544. (1H,5L,3C)

#### 2664: DIGITAL PHOTOGRAPHY

Concepts, terminology, and skills in digital photography. Discover and utilize the appropriate techniques for camera control, exposing techniques, image manipulation and approaches to output options.

RESOURCE CHARGE. Each student MUST own a digital SLR camera. Pre: 1604. (1H,5L,3C)

#### 2704: 3D COMPUTER ANIMATION

Introduction to the basic principles of 3d-computer animation including modeling, texture mapping, lighting, and motion. RESOURCE CHARGE. Pre: 1204, 1404, 1604. (1H,5L,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3004: TOPICS IN ART HISTORY

Rotating topics from all periods of art history with a particular emphasis on non-Western art, such as Japanese, Chinese, pre-Columbian, sub-Saharan, Native American, or Islamic art and architecture. Lecture and/or undergraduate seminar format. May be repeated for credit with different content for a maximum of 9 credits. Pre: 2385 or 2386. (3H,3C) I,II.

#### 3054: ISLAMIC ART AND ARCHITECTURE

Broad survey of the visual arts produced in Islamic cultures from its origins through the contemporary period, with focus on analyzing a variety of visual media within stylistic, cultural, geographic, political, and religious contexts. (3H,3C)

#### 3064: THE ARTS OF CHINA AND JAPAN

An introduction to Chinese and Japanese art from the Neolithic to the present. The influence of philosophy, religion and social organizations on the development of the visual arts in China and Japan. Considerations of a range of media including painting, architecture, calligraphy, ceramics, prints and lacquer. (3H,3C)

#### 3074: EGYPTIAN ART AND ARCHITECTURE

Introduction to Egyptian art and architecture from the Predynastic through the Late Period with emphasis on the major monuments of Egyptian sculpture, painting and architecture and the history of archaeological exploration within Egypt of the Old and New Kingdoms. Pre: 2385. (3H,3C)

#### 3084: GREEK ART AND ARCHITECTURE

Painting, sculpture, and architecture of the Greeks, ca. 1000-31 B.C. Emphasis on correlation of archaeological remains with literary sources, and on the development of the arts in relation to cultural environments of the archaic, classical, and Hellenistic periods. Pre: 2385. (3H,3C) I,II.

#### 3174: TOPICS IN ARCHAEOLOGY

Explores human fascination with, and responsibility to, the physical monuments of the past through a history of the discipline of archaeology in the Mediterranean world. Examines contemporary global issues surrounding the preservation and protection of archaeological artifacts, particularly with regards to the role they serve as objects of cultural heritage and cultural identity. Pre: 2385. (3H,3C)

#### 3184: ROMAN ART AND ARCHITECTURE

Painting, sculpture, and architecture of the Romans 500 B.C. - 323 A.D. Emphasis on relation between monuments and the political and cultural circumstances that led to their creation. Pre: 2385. (3H,3C) I,II.

#### 3284: MEDIEVAL ART AND ARCHITECTURE

The painting, sculpture, and architecture of the 4th through the 14th centuries in the Latin West, with an emphasis on the Romanesque and Gothic Periods. Pre: 2385. (3H,3C) I,II.

#### 3384: RENAISSANCE ART AND ARCHITECTURE

A chronological survey of Renaissance art from the Limbourg Brothers through Mannerism, with an emphasis on painting and architecture. Major stylistic trends are discussed in the historical contexts of

artistic techniques, patronage, iconography and the primary literature of the period. Pre: 2386. (3H,3C)

#### 3484: BAROQUE AND ROCOCO ART AND ARCHITECTURE

Seventeenth-Century Baroque and Eighteenth-Century Rococo Art of Europe, with an emphasis on painting, sculpture, and architecture. Major artistic trends in Italy, Spain, Flanders, Holland, and France are discussed in their historical, cultural, and social context. Pre: 2386. (3H,3C)

#### 3504: TOPICS IN DIGITAL ART AND DESIGN

Rotating topics that explore the computer as an artistic medium and design tool. Intermediate level. The student will encounter an interdisciplinary approach to the use of the computer, as aesthetic ideas are presented and various digital techniques are applied. Stresses use and manipulation of original images created by the student, employing a combination of digital and traditional methods. May be repeated with different content for a maximum of 12 credits. Resource Charge. Pre: 2604. Pre: 1604. (1H,5L,3C)

#### 3514: TOPICS IN DRAWING

Rotating topics in drawing media, approaches, and theories. All topics will be devoted to promoting individual student creativity, mastery of drawing means and techniques, and further understanding of graphic concerns. RESOURCE CHARGE. May be repeated for a maximum of 9 hours with different topics. Pre: 1414 or 2514. (1H,5L,3C)

#### 3524: TOPICS IN PAINTING MEDIA

Rotating topics in painting techniques, disciplines, and theory emphasizing individual creative development and skilled approaches to technical problem-solving in visual art and design. Intermediate level. May be repeated for a maximum of 12 credits. Pre: 2524. (1H,5L,3C)

#### 3544: TOPICS IN CERAMICS

Rotating Topics in special techniques, processes, design concepts and forms in the ceramic arts. May be repeated for a maximum of 12 hours with different topics. FEES REQUIRED. Pre: 2644. (1H,5L,3C)

#### 3554: TOPICS IN SCULPTURE

Rotating topics that will focus on specific technical processes and applications of three dimensional problem solving in the visual arts. The course will stress techniques and issues found in contemporary 3D art and design. Emphasizes intensive studio practice through a series of individual projects related to the topics. FEES REQUIRED. May be repeated for a maximum of 12 credits. Pre: 2554. (1H,5L,3C)

#### 3564: TOPICS IN PHOTOGRAPHY

Rotating topics in photographic materials, methods and philosophies. All topics promote individual student's creativity, master of photographic techniques and further understanding of the medium. RESOURCE CHARGE. May be repeated with different topics for a maximum of 12 credits. Pre: 2664 Pre: 2664. (1H,5L,3C)

#### 3565-3566: INTERMEDIATE GRAPHIC DESIGN I AND II

Intermediate design layout, technical and concept development, and communication skills. First semester emphasizes advanced and new software relevant to the design, advertising, and printing industry. Second semester focuses on typography, professional pre-press, electronic printing and color separation processes. FEE REQUIRED. Pre: 2576 for 3565; 3565 for 3566. (1H,5L,3C)

#### 3574: TOPICS IN GRAPHIC DESIGN

Rotating topics in graphic design, for the intermediate level student. This course will encourage visual problem-solving, conceptual development, clarity and individuality of expression. May be repeated for a maximum of 12 credits. Pre: 2576 Pre: 2576. (1H,5L,3C)

#### 3584: NINETEENTH-CENTURY ART: NEO-CLASSICISM TO POST-IMPRESSIONISM

European art of the nineteenth-century. A chronological study of neoclassicism, romanticism, realism, impressionism, symbolism and post-impressionism. Pre: 2386. (3H,3C) I,II.

#### 3604: TOPICS IN NEW MEDIA ART

Rotating topics explore the computer as an artistic medium and design tool. An interdisciplinary approach to the use of a computer. Aesthetic ideas and application of digital techniques. Use and manipulation of

original images created by the student, employing a combination of digital and traditional methods. RESOURCE CHARGE. May be repeated for a maximum of 12 credits. Pre: 2604. (1H,5L,3C)

#### 3674: HISTORY OF PHOTOGRAPHY

A chronological history of photography, from its invention in the nineteenth-century to the emergence of digital technology. Emphasis on historical, sociological and cultural contexts. Pre: 2386. (3H,3C)

#### 3684: SURVEY OF AFRICAN-AMERICAN ART

A chronological survey of African-American art, from its beginnings in the tribal traditions of Africa to its contemporary manifestations. Pre: 2386 or AFST 2774. (3H,3C)

#### 3704: TOPICS IN COMPUTER ANIMATION

Rotating topics that explore the artistic and design potential of computer animation. Using current digital techniques and methods, focus is on the creation and manipulation of virtual character designs. Students will use an interdisciplinary aesthetic approach to investigate computer animation concepts. RESOURCE CHARGE. May be repeated for credit maximum of 12 credits. Pre: 2704. (1H,5L,3C)

#### 3774: HISTORY OF MODERN GRAPHIC DESIGN

A chronological survey of the history of modern graphic design, from the mid-19th century to 1980. Pre: 2386. (3H,3C)

#### 3784: EUROPEAN AND AMERICAN ART SINCE 1900

European and American Art since 1900. A chronological survey of painting and sculpture from neo-impressionism through post-modernism. Pre: 2386. (3H,3C)

#### 3854: PROFESSIONAL STUDIO PRACTICES

An overview of professional studio art practices, concepts, marketing strategies and promotional materials. The international exhibition system and current educational opportunities, employment and career options in the visual arts are presented. Preparing of written materials and documenting artwork, building a professional portfolio for presentation to potential employers, art galleries and exhibitions are stressed. Pre: Bachelors of Fine Arts (BFA) majors only. (3H,3C)

#### 3884: AMERICAN ART TO 1914

American art from its colonial beginnings until World War I. Pre: 2386. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course. X-grade allowed.

#### 3984: SPECIAL STUDY

Variable credit course.

#### 4384: TOPICS IN ART HISTORY

Advanced art history elective. Rotating topics from all periods of art history, selected to complement offerings at the 3000-level. Topics such as Greek Sculpture, Roman Painting, Renaissance and Baroque Sculpture, Cubism, and Fauvism indicated by timetable. Lecture and/or undergraduate seminar format. May be repeated for credit for a maximum of 18 credits. Pre: 2386. (3H,3C)

#### 4484: TOPICS IN ART CRITICISM AND METHODOLOGY

Advanced art history elective. Rotating topics in the criticism of art and the methodology of art history and criticism, selected to complement offerings at the 3000-level. Topics such as the History of Art Criticism from Baudelaire to the Present, New Methods in Renaissance and Baroque Art History, and the Theory of Art from various periods, indicated by timetable. Lecture and/or undergraduate seminar format. May be repeated for credit with different content to a maximum of 9 credits. Pre: 2385 or 2386. (3H,3C)

#### 4504: TOPICS IN MULTIMEDIA STUDIO

This studio course investigates computer-based multimedia in the visual arts and applied design. Video, photography, computer art and design may be used with traditional media and communication vehicles. May be repeated for a maximum of 9 credits. Two 3000-level courses required. Pre: (1414, 1604) or (1504, 1514, 2504). (1H,5L,3C)

#### 4514: INTERARTS STUDIO

This studio course will investigate new approaches to art-making and new genres, such as performance art and site-specific installation. Interdisciplinary basis for course may incorporate traditional studio practices and media in the visual arts, music and theatre arts, and appropriate technology in computer, video, and film. May be repeated for a maximum of 12 credits with different topics. 3000-level course in Studio or Art History or departmental approval. RESOURCE CHARGE. (1H,5L,3C)

#### 4524: PICTORIAL ARTS STUDIO

Rotating topics in the two dimensional arts, at an advanced level. All topics will challenge the student to develop stronger, independently generated work of portfolio quality. May be repeated for a maximum of 9 credits with different topics. 3000-level Painting or Drawing course required. RESOURCE CHARGE Pre: 3524 or 3514. (1H,5L,3C)

#### 4534: TOPICS IN APPLIED ART AND DESIGN STUDIO

Rotating topics about functional art and design. Students will use appropriate materials, tools, and processes in the creation of functional artworks, such as furniture, tiles, tableware, etc. Function and design aesthetics emphasized. May be repeated for a maximum of 9 credits with different topics. RESOURCE CHARGE Pre: 3544. (1H,5L,3C)

#### 4544: COMPUTER ANIMATION STUDIO

Advanced animation course focusing on the creation of short films, demo reels, and expressive computer animated films. Students enrolled in this course are expected to complete one large project during the semester. May be repeated with different course content for up to nine credit hours. Pre: 3704 or 3704. (1H,5L,3C)

#### 4554: SPATIAL ARTS STUDIO

Advanced level, rotating topics in the three dimensional arts. All topics will challenge the student to develop stronger, independently generated work of portfolio quality. May be repeated for a maximum of 9 credits with different topics. 3000-level Ceramics, Sculpture or Applied Art course required. RESOURCE CHARGE Pre: 3554. (1H,5L,3C)

#### 4564: EXHIBITION DESIGN AND DISPLAY

This course will focus on the display and presentation of visual art, for student-designed exhibitions. Provides experience in the public art arena, and practical knowledge about planning, designing, and mounting an exhibition. Pre: 3000-level Studio or Art History course required. (1H,5L,3C)

#### 4574: ADVANCED VISUAL COMMUNICATIONS

A further refinement of design theory and practice, and communication skills. Emphasis on the conceptual development of expanded project formats, and individual creativity. This class will provide a principal opportunity for building a viable portfolio. RESOURCE CHARGE 6 credits of Art 3574 required. Pre: 4504. (1H,5L,3C)

#### 4575-4576: ADVANCED VISUAL COMMUNICATION DESIGN

Refinement of design theory, practice, and communication skills. Emphasis placed on methodologies and strategies for developing a personal identity, website, and/or multimedia portfolio. Development of professional brand identity through web design, design of business cards, letterhead, envelopes, and electronic media. Pre: 3566 for 4575; 4575 for 4576. (1H,6L,3C)

#### 4584: ADVANCED TYPOGRAPHY

Advanced study of Typography as it relates to Visual Communication Design including historical and contemporary context. Terminology and advanced applications of Typography, complex grid systems, experimental typographic methods, and material studies. Pre: 2566. (1H,6L,3C)

#### 4754: INTERNSHIP

Variable credit course. X-grade allowed. 4804: NEW MEDIA ART THEORY Exploration of new media theory in relationship to contemporary arts practice. Overview and application of new media art aesthetics, strategies, trends, and socio-cultural aspirations. The course will examine theoretical writings and creative

work from prevailing technologically-based disciplines. Pre: 2385, 2386. (3H,3C)

**4894: SENIOR STUDIO**

Preparation and presentation of concentrated studio work under faculty supervision, culminating in solo exhibition and/or formal portfolio. May be extended over two semesters with final grade assigned on completion. Or may be repeated for a total of 6 credits at a maximum of 3H, 3C per semester. Senior standing and consent of department head required. Variable credit course. I,II,III.

**4964: FIELD STUDY**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course.

**4974H: INDEPENDENT STUDY**

Variable credit course.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.

**4994H: UNDERGRADUATE RESEARCH**

Variable credit course.





## 2016-2017 Undergraduate Course Catalog and Academic Policies

### School of Public and International Affairs

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#### Overview

#### Undergraduate Course Descriptions (SPIA)

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**Director:** A. Khademian

**Executive Committee:** G. Datz, A. Eckerd, K. Hult, T. Luke, K. Wernstedt, and D. Zahm

Web: [www.spia.vt.edu](http://www.spia.vt.edu)

### Overview

The School of Public and International Affairs (SPIA) provides opportunities for students interested in public issues to gain perspectives and skills from several related disciplines. SPIA is a school within the College of Architecture and Urban Studies, and is comprised of the Center for Public Administration and Policy, the Government and International Affairs Program, and the Urban Affairs and Planning Program. Undergraduate degrees are offered by Urban Affairs and Planning â€” a B.S. in Environmental Policy and Planning and a B.A. in Public and Urban Affairs (see Urban Affairs and Planning in this catalog).

SPIA sponsors the Washington Semester, a ten-week summer program that allows undergraduate students to combine Washington, D.C.-area internships with course work for academic credit. For more information about undergraduate degree programs, students should contact Urban Affairs and Planning. Information on graduate programs may be obtained from the Center for Public Administration and Policy, Government and International Affairs, and Urban Affairs and Planning.

### Undergraduate Course Descriptions (SPIA)

2984: SPECIAL STUDY  
Variable credit course.

4984: SPECIAL STUDY  
Variable credit course.

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# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Statistics

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[Undergraduate Course Descriptions \(STAT\)](#)

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**Head:** E. P. Smith

**Professors:** J. B. Birch, I. Hoeschele, S. Keller, J.P. Morgan, E. P. Smith, G.G. Vining, and W.H. Woodall

**Associate Professors:** P. Du, M. Ferreira, F. Guo, Y. Hong, I. Kim, S. Leman, and G. R. Terrell

**Assistant Professors:** X. Deng, F. Guo, Y. Hong, L. House, J. Li, R. Tang, X. Wu, and H. Zhu

**Assistant Research Professors:** C. Franck, J. Li, and E. Vance

**Professor of Practice:** A. Driscoll and J. Robertson Evia

**Instructors:** C. Tavera

Web: [www.stat.vt.edu](http://www.stat.vt.edu)

## Overview

Statistics courses are offered at both the undergraduate and the graduate levels for students preparing for professions in statistics, for students who need statistical tools to engage in scientific research, and for

students who want to acquire knowledge of the important concepts of probability and statistical inference.

Statistics courses for graduate students and programs leading to the M.S. and Ph.D. degrees in statistics are described in the [Graduate Catalog](#) and in a special bulletin available from the department.

## Bachelor of Science in Statistics

All statistics majors are required to own specified personal computers and software. Consult the department for details.

A special brochure describing the department and the B.S. program, intended for prospective entering freshmen, is available from the department upon request.

Cooperative Education and Internship positions are available in industry and government, offering valuable practical experience. Students participating in such an experience can receive academic credit which will count towards graduation requirements.

### Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

### Minor in Statistics

Please visit the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html> to view requirements for the minor.

The department reserves the right to withhold credit if a student takes a course, the content of which is partially duplicated in a course already taken (see "Course Duplications" below).

## Laboratory for Interdisciplinary Statistical Analysis (LISA)

Associated with the statistics department, the Laboratory for Interdisciplinary Statistical Analysis (LISA) provides statistical assistance for research projects throughout the university community. Faculty members, staff, and students are available to aid in statistical design and analysis for any authorized research study here at the university and at other state agencies.

### Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Statistics can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Course Duplications

- No credit will be given for 2004 if taken with or after any other statistics course
- For non-majors, all of the following are partial duplications: 3005, 3604, 3615, 4604, and 4705.
- For majors, 4604 and 4705 may replace 3005 if taken before becoming a major.
- All the following are partial duplications: 3006, 3616, and 4706.
- No credit will be given for 3704 if taken after any of the following: 3005, 3615, 4604, and 4705.
- BIT 2405 may not be used as a substitute for credit as a statistics course unless the student was officially registered as a Business major at the time BIT 2405 was taken.

## Computer Literacy

Many statistics courses involve the use of statistics software, primarily MINITAB, SAS, JMP or R. Experience with the software is not expected, but students should have familiarity with either the Windows or Macintosh operating system and have access to a computer.

## Course Projects

Many of the upper-division courses include a project, generally to be completed in small groups. These projects are designed to give students the kind of insight and experience in realistic statistical practice that cannot be obtained in classroom lectures or short-term homework assignments.

## Undergraduate Course Descriptions (STAT)

### 1004: THE FIRST YEAR EXPERIENCE IN LEARNING FROM DATA

Introduction to the field of statistics and aspects of college life for first year students. Topics included: history of the statistics; key roles of statisticians in field, such as actuarial sciences, pharmaceutical, medical, and bioinformatics industries, governmental agencies, academia; fundamental principles of statistical fields of study and applications; exploring data sets; and aspects of college life for first-year students. (2H,2C)

### 2004: INTRODUCTORY STATISTICS

Fundamental concepts and methods of statistics with emphasis on interpretation of statistical arguments. An introduction to design of experiments, data analysis, correlation and regression, concepts of probability theory, sampling errors, confidence intervals, and hypothesis tests. (See also Course Duplications). Pre: MATH 1015 or MATH 1014. (4H,3C)

### 2524: DATA SCIENCE

Organize, summarize, and visualize large-scale datasets from web studies. Interpret visualizations and communicate information discovered by data explorations. Program in R or comparable statistics programming language. Not intended for statistics majors. Pre: (3005 or 3615), (MATH 1114, MATH 1206 or MATH 2015), (CS 1054 or CS 1064). (3H,3C)

### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

### 2974H: INDEPENDENT STUDY

Honors section. Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3005-3006: STATISTICAL METHODS

3005: Basic statistical methodology: exploratory data techniques, estimation, inference, comparative analysis by parametric, nonparametric, and robust procedures. Analysis of variance (one-way), multiple

comparisons, and categorical data. 3006: Analysis of variance, simple and multiple, linear and nonlinear regression, analysis of covariance. Use of MINITAB. STAT 3005 duplicates STAT 3615 and STAT 4604, only one may be taken for credit. STAT 3006 duplicates STAT 3616, STAT 4604 and STAT 4706, only one may be taken for credit. Pre: MATH 1206 or MATH 1226 for 3005; 3005 for 3006. (3H,3C)

#### 3094: SAS PROGRAMMING

Introduction to basic programming techniques: creating DATA and PROC statements, libraries, functions, programming syntax and formats. Other topics include loops, SAS Macros and PROC IML. Emphasis is placed on using these tools for statistical analyses. The pre-requisite may be substituted for an equivalent course. Pre: 3005. (3H,3C)

#### 3104: PROBABILITY AND DISTRIBUTIONS

Probability theory, including set theoretic and combinatorial concepts; in-depth treatment of discrete random variables and distributions, with some introduction to continuous random variables; introduction to estimation and hypothesis testing. Pre: (MATH 1206 or MATH 1226 or MATH 2015 or MATH 1026 or MATH 1526), (STAT 3005 or STAT 3615). (3H,3C)

#### 3424: INTRODUCTION TO STATISTICAL NEUROSCIENCE AND IMAGE ANALYSIS

Analysis of data arising in studies in neuroscience and from fMRI neuroimaging. Topics include background on neuroscience and the brain, overview of structural and functional MRI data, introduction to MATLAB, overview of linear models, contrasts, and statistical parametric mapping, experimental design, and Bayesian analysis. Pre: 3006 or 3616. (3H,3C)

#### 3504: NONPARAMETRIC STATISTICS

Statistical methodology based on ranks, empirical distributions, and runs. One and two sample tests, ANOVA, correlation, goodness of fit, and rank regression, R-estimates and confidence intervals. Comparisons with classical parametric methods. Emphasis on assumptions and interpretation. Pre: 3006 or 3616 or 4106 or 4604 or 4706. (3H,3C)

#### 3604: STATISTICS FOR THE SOCIAL SCIENCES

Statistical methods for nominal, ordinal, and interval levels of measurement. Topics include descriptive statistics, elements of probability, discrete and continuous distributions, one and two sample tests, measures of association. Emphasis on comparison of methods and interpretations at different measurement levels. (See also Course Duplications). Pre: MATH 1015 or MATH 1014. (3H,3C)

#### 3615-3616: BIOLOGICAL STATISTICS

Descriptive and inferential statistics in a biological context. 3615: Fundamental principles, one- and two-sample parametric inference, simple linear regression, frequency data. 3616: One- and two-way ANOVA, multiple regression, correlation, nonparametrics, using the MINITAB computer package. STAT 3615 partially duplicates STAT 3005 and STAT 4604, only one may be taken for credit. STAT 3616 partially duplicate STAT 3006, 4604 and 4706, only one may be taken for credit. (3H,3C)

#### 3654 (CMDA 3654) (CS 3654): INTRODUCTORY DATA ANALYTICS & VISUALIZATION

Basic principles and techniques in data analytics; methods for the collection of, storing, accessing, and manipulating standard-size and large datasets; data visualization; and identifying sources of bias. Pre: CMDA 2006. (3H,3C)

#### 3704: STATISTICS FOR ENGINEERING APPLICATIONS

Introduction to statistical methodology with emphasis on engineering experimentation: probability distributions, estimation, hypothesis testing, regression, and analysis of variance. Only one of the courses 3704, 4604, 4705, and 4714 may be taken for credit. Pre: MATH 2224 or MATH 2204 or MATH 2204H. (2H,2C)

#### 4004: METHODS OF STATISTICAL COMPUTING

Computationally intensive computer methods used in statistical analyses. Statistical univariate and multivariate graphics; resampling methods including bootstrap estimation and hypothesis testing and simulations; classification and regression trees; scatterplot smoothing and splines. Pre: (4105, 4214). (4H,3C)

#### 4024: COMMUNICATION IN STATISTICAL COLLABORATIONS

Theory and examples of effective communication in the context of statistical collaborations. Practice developing the communication skills necessary to be effective statisticians using peer feedback and self-reflection. Topics include helping scientists answer their research questions, writing about and presenting statistical concepts to a non-statistical audience, and managing an effective statistical collaboration meeting. Pre-requisite: Senior standing in the Department of Statistics Pre: 4105, 4204. Co: 4214. (3H,3C)

#### 4094: INTRODUCTION TO PROGRAMMING IN R

Introduction to R programming techniques with an emphasis on statistical analyses. Topics include: data objects, loops, importing/exporting datasets, graphics, functions, t-tests, ANOVA, linear regression, nonparametric tests, and logistic regression. Pre: 3615. (1H,1C)

#### 4105-4106: THEORETICAL STATISTICS

4105: Probability theory, counting techniques, conditional probability; random variables, moments; moment generating functions; multivariate distributions; transformations of random variables; order statistics. 4106: Convergence of sequences of random variables; central limit theorem; methods of estimation; hypothesis testing; linear models; analysis of variance. STAT 4105 partially duplicates STAT 4705, STAT 4714, and STAT 4724, only one may be taken for credit. Pre: MATH 2224 for 4105; 4105 for 4106. (3H,3C)

#### 4204: EXPERIMENTAL DESIGNS

Fundamental principles of designing and analyzing experiments with application to problems in various subject matter areas. Discussion of completely randomized, randomized complete block, and Latin square designs, analysis of covariance, split-plot designs, factorial and fractional designs, incomplete block designs. Pre: 3006 or 3616 or 4106 or 4706 or 5605 or 5615. (3H,3C)

#### 4214: 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. Pre: 3006 or 3616 or 4106 or 4706 or 5606 or 5616. (3H,3C)

#### 4364: INTRODUCTION TO STATISTICAL GENOMICS

Statistical methods for bioinformatics and genetic studies, with an emphasis on statistical analysis, assumptions, and problem-solving. Topics include: commonly used statistical methods for gene identification, association mapping and other related problems. Focus on statistical tools for gene expression studies and association studies, multiple comparison procedures, likelihood inference and preparation for advanced study in the areas of bioinformatics and statistical genetics. Pre: (3006, MATH 1206, CS 1044) or (STAT 3006, MATH 1206, CS 1054) or (STAT 3006, MATH 1206, CS 1114). (3H,3C)

#### 4444: APPLIED BAYESIAN STATISTICS

Introduction to Bayesian methodology with emphasis on applied statistical problems: data displaying, prior distribution elicitation, posterior analysis, models for proportions, means and regression. Pre: MATH 2224, (STAT 3104 or STAT 4105 or STAT 4705), (STAT 3006 or STAT 3616 or STAT 4706). (3H,3C)

#### 4504: APPLIED MULTIVARIATE ANALYSIS

Non-mathematical study of multivariate analysis. Multivariate analogs of univariate test and estimation procedures. Simultaneous inference procedures. Multivariate analysis of variance, repeated measures, inference for dispersion and association parameters, principal components analysis, discriminate analysis, cluster analysis. Use of SAS. Pre: 3006 or 4706 or 5606 or 5616. (3H,3C)

#### 4514: 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 and SPSSx. Pre: 3006 or 3616 or 4106 or 4706 or 5606 or 5616. (3H,3C)

#### 4524: 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 questionnaires and organization of a survey. Pre: 3006 or 3616 or 4106 or 4706 or 5606 or 5616. (3H,3C)

#### 4534: APPLIED STATISTICAL TIME SERIES ANALYSIS

Applied course in time series analysis methods. Topics include regression analysis, detecting and address autocorrelation, modeling seasonal or cyclical trends, creating stationary time series, smoothing techniques, forecasting and forecast errors, and fitting autoregressive integrated moving average models. Pre: 3006 or 4104 or 4706 or 4714 or 3616 or BIT 2406. (3H,3C)

#### 4584 (MATH 4584): ADVANCED CALCULUS FOR STATISTICS

Introduction to those topics in advanced calculus and linear algebra needed by statistics majors. Infinite sequences and series. Orthogonal matrices, projections, quadratic forms. Extrema of functions of several variables. Multiple integrals, including convolution and nonlinear coordinate changes. Pre: (MATH 1114 or MATH 2114 or MATH 2114H), (MATH 1205 or MATH 1225), (MATH 1206 or MATH 1226), (MATH 2224 or MATH 2204 or MATH 2204H). (3H,3C)

#### 4604: STATISTICAL METHODS FOR ENGINEERS

Introduction to statistical methodology with emphasis on engineering applications: probability distributions, estimation, hypothesis testing, regression, analysis of variance, quality control. Only one of the courses 4604, 4705, and 4714 may be taken for credit. STAT 4604 partially duplicates STAT 3005, STAT 3615, STAT 3006, STAT 3616 and STAT 4706. Only one may be taken for credit. Pre: MATH 1206 or MATH 1226. (3H,3C)

#### 4654 (CMDA 4654) (CS 4654): INTERMEDIATE DATA ANALYTICS AND MACHINE LEARNING

A technical analytics course. Covers supervised and unsupervised learning strategies, including regression, generalized linear models, regularization, dimension reduction methods, tree-based methods for classification, and clustering. Upper-level analytical methods shown in practice: e.g, advanced naive Bayes and neural networks. Pre: CMDA 2006. (3H,3C)

#### 4664 (CMDA 4664): COMPUTATIONAL INTENSIVE STOCHASTIC MODELING

Stochastic modeling methods with an emphasis in computing are taught. Select concepts from the classical and Bayesian paradigms are explored to provide multiple perspectives for how to learn from complex, datasets. There is particular focus on nested, spatial, and time series models. Pre: CMDA 2006. (3H,3C)

#### 4705-4706: PROBABILITY AND STATISTICS FOR ENGINEERS

Basic concepts of probability and statistics with emphasis on engineering applications. 4705: Probability, random variables, sampling distributions, estimation, hypothesis testing, simple linear regression correlation, one-way analysis of variance. 4706: Multiple regression, analysis of variance, factorial and fractional experiments. Only one of the courses 3704, 4604, 4705, 4714, and 4724 may be taken for credit. Pre: MATH 2224 or MATH 2204 or MATH 2204H for 4705; 4705 or 4105 for 4706. (3H,3C)

#### 4714: PROBABILITY AND STATISTICS FOR ELECTRICAL ENGINEERS

Introduction to the concepts of probability, random variables, estimation, hypothesis testing, regression, and analysis of variance with emphasis on application in electrical engineering. Only one of the courses 3704, 4604, 4705, 4714 and 4724 may be taken for credit. Pre: MATH 2224 or MATH 2204 or MATH 2204H. (3H,3C)

#### 4804 (AAEC 4804): ELEMENTARY ECONOMETRICS

Economic applications of mathematical and statistical techniques: regression, estimators, hypothesis testing, lagged variables, discrete variables, violations of assumptions, simultaneous equations. Pre: (3005 or 3604), (AAEC 1006). (3H,3C)

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.



4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Honors section. Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Honors section. Variable credit course.

# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Science and Technology in Society

### Overview

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[Humanities, Science, and Technology Minor \(HST\)](#)

[Science and Technology Concentration \(ST\)](#)

[Medicine and Society Minor \(MSOC\)](#)

[Gender, Science, and Technology Minor \(GST\)](#)

[Graduate Program](#)

[Undergraduate Course Descriptions \(STS\)](#)

**Head:** Daniel Breslau

**Alumni Distinguished Professor:** G.L. Downey

**Professor:** B.L. Allen

**Associate Professors:** J.E. Abbate, D. Breslau, J. H. Collier, E. Crist Patzig, S.E. Halfon, S. Schmid, and M. Wisnioski

**Assistant Professors:** A.S. Heflin, R. Hester, and P.R. Olson

**Emeritus Professor:** R.M. Burian, E.R. Fuhrman, A.F. LaBerge, and D.T. Zallen

**Director of Graduate Studies:** S. E. Halfon

**Director of Undergraduate Studies:** J. H. Collier

**Undergraduate Coordinator:** Carol Sue Slusser

Web: [www.sts.vt.edu](http://www.sts.vt.edu)

## Overview

The Department of Science and Technology in Society (STS) offers interdisciplinary work at both the undergraduate and graduate levels that contributes to our understanding of the relations among science, technology, and society. At the undergraduate level, it offers five minors.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Humanities, Science, and Environment Minor (HSE)

This minor provides an interdisciplinary approach to environmental issues, integrating humanities, social sciences, and natural sciences to understand the relationship between people and the natural world.

## Humanities, Science, and Technology Minor (HST)

This minor may be designed to emphasize combinations of moral, aesthetic, intellectual, political, historical, philosophical, and sociological dimensions of science, technology, and medicine, through case studies and in-depth analysis. Students work with the undergraduate coordinator in STS to design a coherent program.

## Science and Technology Concentration (ST)

This individualized concentration requires in-depth study and practice of theories and methods of science and technology. Students choose a concentration in one science or technology program; coupled with 9 credit hours of STS courses; the student's program of study must be approved by the STS undergraduate coordinator. In some fields, more than 18 credit hours may be required to complete the concentration.

## Medicine and Society Minor (MSOC)

The Medicine and Society minor focuses on the humanistic aspects of medical practice, pressing bioethical questions, and the subjective experience of illness and health. The MSOC minor provides an essential education for anyone curious about the role of medicine in past eras and contemporary culture, and it provides an excellent background for those considering a career in medicine or other health care professions. The minor requires 21 credit hours with at least 14 hours at the 3000 or 4000 level.

Faculty advisors as well as other program information are available on the MSOC Scholar site. Log in to Scholar and go to MY WORKSPACE. Click on MEMBERSHIP, and then click on JOINABLE SITES. Scroll through until MEDICINE AND SOCIETY appears. Students have to join the site as a guest in order to see the pages. Once enrolled, students will be added as participants.

## Gender, Science, and Technology Minor (GST)

Co-developed by Women's Studies and STS, this minor offers the opportunity for students to cultivate an understanding of the complex ways in which gender is defined in relation to science and technology, and science and technology are defined in relation to gender. The minor coordinator is the Director of the Women's Studies Program.

Contact Carol Sue Slusser in 121 Lane Hall or via email at [slusserc@t.edu](mailto:slusserc@t.edu), for more information or to

enroll in one of these minors.

## Graduate Program

STS jointly administers the Science and Technology Studies Graduate Program with the departments of History, Philosophy, Political Science, and Sociology. The program offers the M.S. and Ph.D. degrees at both the Blacksburg and National Capital Region campuses. (See the [Graduate Catalog](#) for further information.)

## Undergraduate Course Descriptions (STS)

### 1504: INTRODUCTION TO SCIENCE, TECHNOLOGY, AND SOCIETY

Introduction to the interrelationship among science, technology, and society. Study of how science, including medicine, and technology are defined and analyzed by the humanities and social sciences. Examination of topics, theories, and methods of the field of Science and Technology Studies. Depiction of the dynamics of scientific and technological controversies including the roles knowledge, expertise, risk, rhetoric and public understanding play in policy making. (3H,3C)

### 2054 (HIST 2054): ENGINEERING CULTURES

Development of engineering and its cultural roles in historical and cross-national perspectives. Explores roles of engineers and engineering in popular life, development of national styles, changing values in engineering problem solving, and effects of evolving forms of capitalism. (3H,3C)

### 2154: HUMANITIES, TECHNOLOGY, AND THE LIFE SCIENCES

Examines the value-laden issues surrounding the professional dimensions of research in the biological and life sciences and provides humanistic perspectives on the role and function of science in society. (3H,3C)

### 2354: HUMANITIES, TECHNOLOGY, AND THE PHYSICAL SCIENCES

Examines the value-laden issues surrounding the professional dimensions of research in the physical sciences and technology, and provides humanistic perspectives on the role and function of science in society. (3H,3C)

### 2464 (RLCL 2464): RELIGION AND SCIENCE

Exploration of the relationships between religion and science in the western tradition. Topics include: basic frameworks for relationships between religion and science in historical and cultural context, types of human knowledge and truth, similarities and differences between science and religion, evolution, ecology, and contemporary issues. (3H,3C)

### 2974: INDEPENDENT STUDY

Variable credit course.

### 2974H: INDEPENDENT STUDY

Variable credit course.

### 2984: SPECIAL STUDY

Variable credit course.

### 3105,3106: SCIENCE AND TECHNOLOGY IN MODERN SOCIETY

Examination of science and technology as social and cultural activities in the modern world. 3105: institutions and values in science and technology; 3106: value conflicts and decision making in science and technology. (3H,3C)

### 3314: MEDICAL DILEMMAS AND HUMAN EXPERIENCE

This course will explore medical dilemmas from a humanistic perspective, including topics related to assisted reproduction, genetic testing and treatment, organ transplantation, clinical trials, end-of-life interventions, and decisions regarding allocation of health-care resources. (3H,3C)

### 3334: ENERGY AND SOCIETY

Examines the interconnections between energy use and social life. Considers the ways that modern social institutions, such as states, cities, and households are shaped by energy systems, particularly the pervasive use of fossil fuels. Explores the influence of energy extraction and commerce on economic development and global politics. Surveys major contemporary problems related to energy, including climate change and natural resource depletion. Develops an interdisciplinary framework, drawing insights from history, sociology, and economics, for evaluating policies to transition to a sustainable energy system. (3H,3C)

### 3705,3706 (HIST 3705, 3706): HISTORY OF SCIENCE

Conceptual and institutional development of physical and biological sciences viewed within a cultural and societal context. 3705: Early Science; 3706: Modern Science (3H,3C)

### 3715,3716 (HIST 3715, 3716): HISTORY OF TECHNOLOGY

Description of the development of technology and engineering in their social contexts. 3715: from prehistory to the industrial revolution in Europe and the United States, mid-19 century; 3716: from mid-19th century to the present. (3H,3C)

### 3734 (HIST 3734): HISTORY OF MODERN BIOLOGY

This course explores the development of biology from the Enlightenment to the end of the twentieth century, with a particular emphasis on biology's impact on society. (3H,3C)

### 3984: SPECIAL STUDY

Variable credit course.

### 4304: CONTEMPORARY ISSUES IN SCIENCE, TECHNOLOGY, AND SOCIETY

Examination of social and cultural issues that shape, and are shaped by, the conduct of scientific, technological, and medical research and activity. Topics such as human genetic and technological enhancement; surveillance technologies and civil rights; environmental intervention and preservation; precautionary and proactionary approaches to public policy making. Course repeatable up to 12 hours with different topics. Junior Standing. Pre: STAT 1504. (3H,3C)

### 4314 (ENGL 4314): NARRATIVE MEDICINE

Introduction to the field of narrative medicine, with attention to narrative competencies, the use of narrative medical education, and the function of narratives in the experience of healing. Includes narrative approaches to biomedical ethics. Pre: ENGL 3154 or ENGL 3324. (3H,3C)

### 4334 (SOC 4334) (WGS 4334): SEXUAL MEDICINE

Discusses sex and medicine in contemporary U.S. society. Explores how notions of sexual behavior and "normality" are defined and structured by medical discourse. Examines cultural institutions that play significant roles in formulating ideas about and definitions of deviance, perversity, and tolerated marginality. Critiques medical responses to sexual variations. Examines experiences of people who have sought out, or been the unwilling victims of, sexual medicine. Junior standing required. Pre: WGS 1824. (3H,3C)

### 4704 (WGS 4704): GENDER AND SCIENCE

Investigates the gender dimensions of science in both historical and contemporary perspectives. Discusses feminist studies of science, exploring strengths and limitations. Assess implications of cultural assumptions about gender for practicing scientists. A 3000 level course in science or engineering may satisfy the prerequisite. Pre: 1504 or WGS 2244. (3H,3C)

### 4754: INTERNSHIP

Variable credit course.

### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

### 4974: INDEPENDENT STUDY

Variable credit course.

4974H: INDEPENDENT STUDY

Variable credit course.

4984: SPECIAL STUDY

Variable credit course.

4994: UNDERGRADUATE RESEARCH

Variable credit course.

4994H: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Systems Biology

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### Overview

### Bachelor of Science in Systems Biology

### Satisfactory Progress

### Undergraduate Course Descriptions (SYSB)

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**Division Leader:** J. Tyson

**Program Manager:** N. Sullivan

**Principle Faculty:** W. Baumann, D. Bevan, Y. Cao, S. Ciupe, R. Jensen, I. Lazar, L. Li, T. E. Long, W. Mather, and T.M. Murali

Web: [www.science.vt.edu/ais/sysb](http://www.science.vt.edu/ais/sysb)

## Overview

The Systems Biology program is a joint effort of the departments of Biological Sciences, Physics, Chemistry, Mathematics and Computer Science. The program resides in, and is organized as a division of, the College of Science's Academy of Integrated Science.

A "systems approach" to biology involves the study of the biological, chemical, and physical processes within living organisms as they interact in complex ways to produce life-supporting behaviors. The Virginia Tech program in Systems Biology focuses on the powerful, emerging paradigm of molecular systems biology, i.e., on computational, systems-level approaches that connect the biochemical and genetic properties of individual macromolecules (DNA, RNA, protein, lipids, polysaccharides) with the physiological behavior of living cells and tissues. These levels of biological organization, which comprise the gap between interacting macromolecules and cell physiology, embody an active area of research producing technological and biomedical innovations. The Systems Biology program bridges the molecular/cell divide, training students for employment or graduate education in this burgeoning field.

# Bachelor of Science in Systems Biology

All Systems Biology majors are required to own specified personal computers and software. Consult the division for details.

A special brochure describing the division and the B.S. program in Neuroscience is available from the division's webpage or upon request.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree.

Satisfactory progress requirements toward the B.S. in Systems Biology can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (SYSB)

### 2025-2026: INTRODUCTION TO SYSTEMS BIOLOGY

Introduction to the fundamental ideas and methods of systems biology by a series of case studies. Applications of statistical methods and computer simulation. 2025: Genome analysis, molecular network architecture, dynamical systems. 2026: Molecular regulatory systems, metabolic pathways, data mining. Pre: ISC 1106 or (BIOL 1105, CHEM 1036, MATH 1206) for 2025; 2025 for 2026. (3H,3L,3C)

### 2984: SPECIAL STUDY

Variable credit course.

### 3035-3036: SYSTEMS BIOLOGY OF GENES AND PROTEINS

Experimental techniques in genomics, transcriptomics, and proteomics. Mathematical, statistical, and computational models and methods to analyze these data. Techniques for integrating data from different experiments. Case studies and specific applications in molecular biology, including cancer and infectious diseases. 3035: genomics, transcriptomics. 3036: proteomics, interactomics, data integration. Pre: 2026. (3H,3L,4C)

### 3115-3116: NETWORK DYNAMICS AND CELL PHYSIOLOGY

In-depth study of how molecular regulatory networks determine the physiological properties of prokaryotic and eukaryotic cells. 3115: Biochemical reaction networks, nonlinear dynamical systems, parameter estimation, bifurcation theory, switches and oscillators, gene regulatory networks, signaling pathways, metabolic networks, neural networks, applications. 3116: Stochastic effects, cell cycle and cancer, spatial effects, motility, development, tissue dynamics, applications. Pre: 2026 for 3115; 3115 for 3116.



(3H,3L,4C)

**4065-4066: RESEARCH EXPERIENCE IN SYSTEMS BIOLOGY**

Training and practical experience in the conduct of systems biology research. 4065: Planning a research project and initial execution. 4066: Refine, complete, and document projects results. Pre: 3036, 3116 for 4065; 4065 for 4066. Co: 4135 for 4065; 4136 for 4066. (4H,4C)

**4135-4136: PROFESSIONALISM IN SYSTEMS BIOLOGY**

Training and practical experience in ethical standards of science. 4135: Systems biology, proposal writing, ethical issues, the impact of systems biology on national and global issues, career options. 4136: Oral and written presentations, management and social issues, current literature and developments in systems biology. Pre: 3036, 3116 for 4135; 4135 for 4136. Co: 4065 for 4135; 4066 for 4136. (2H,2C)

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.



## 2016-2017 Undergraduate Course Catalog and Academic Policies

### Theatre and Cinema

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[Overview](#)

[Satisfactory Progress](#)

[Undergraduate Course Descriptions \(CINE\)](#)

[Undergraduate Course Descriptions \(FA\)](#)

[Undergraduate Course Descriptions \(TA\)](#)

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**Director, School of Performing Arts | Music | Theatre | Cinema:** Patricia Raun

**Faculty Chair:** Susanna Rinehart

**Professors:** R. H. Leonard, B. F. Lepczyk, S. Prince, P. Raun, and R. W. Ward

**Associate Professors:** J. Ambrosone, W. S. Barksdale, D. W. Johnson, G. W. Justice, P. S. Lavender, R. McGrath, C. Rawlings, and S. C. Rinehart

**Assistant Professors:** C. Dye, A. Nelson, J. Stein, and N. Staley

**Instructors:** K. Precoda and C. Russo

**Career Advisors:** G. W. Justice and R. W. Ward

**Academic Advisor:** P. S. Lavender

**Emeritus Professors:** P. A. Distler, D. A. Drapeau, B. Dukore, and F. N. Proctor

Web: [www.theatrecinema.vt.edu](http://www.theatrecinema.vt.edu)

### Overview

The curriculum in Theatre and Cinema is designed to provide the student with the essential approaches necessary to develop an informed understanding of Theatre and Cinema literature and its practice. As such, the three basic aspects of the disciplines (the theoretical, the historical, and the practical) are emphasized.

A program in theatre arts leading to the B.A. is offered. In addition to fulfilling the core curriculum requirements of the College of Liberal Arts and Human Sciences and the Curriculum for Liberal

Education, general majors must complete a minimum of 48 hours in theatre arts. Students who choose a degree option in Performance, Design, or Cinema, must complete a minimum of 57 hours.

A minor course of study in theatre arts may be chosen with the guidance of the student's advisor.

Limited scholarship support is available.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Theatre Arts.

Satisfactory progress requirements toward the B.A. in Theatre Arts can be found on the major checksheet by visiting the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (CINE)

### 2054: INTRODUCTION TO CINEMA

Introduction to cinema as a medium for artistic communication. (2H,3L,3C)

### 2064: INTRODUCTION TO CINEMA PRODUCTION

Introductory filmmaking course. Thematic conception and story construction, writing, producing, directing, cinematography, sound recording, and editing. (3H,3C)

### 3005,3006: DIGITAL CINEMA PRODUCTION

Basic production techniques, aesthetics, and technology of cinema production. Pre: (2054 or COMM 2054 or TA 2054) for 3005; (2054 or TA 2054 or COMM 2054) for 3006. (4H,3C)

### 3184: CINEMA PRODUCTION TOPICS

Rotating topics in cinema production. Designed for majors in the Department of Theatre and Cinema who have foundational training in areas of cinema production. May be repeated for credit with different course content up to a maximum of nine credit hours. (Variable credit) Variable credit course. Pre: TA 3006 or CINE 3006.

### 3214: FICTION CINEMA PRODUCTION

Intermediate-level fiction film production course. Foundational cinema production skills, dramatic storytelling techniques, intermediate directing, team-based ownership and responsibility, and project management. Pre: 2054, (2064 or 3005). (3H,3C)

### 3224: DOCUMENTARY CINEMA PRODUCTION

Intermediate-level, non-fiction, film production course for students seeking non-fiction documentary film production skills and experience. Emphasizes the application and advancement of foundational skills, the ethics of documentary filmmaking, story development and project management. Pre: 2054, (2064 or 3005). (3H,3C)

### 3444 (AFST 3444) (SOC 3444): AFRICAN AMERICAN IMAGES IN FILM

Explores race and representations of African American images in film, from multiple disciplinary perspectives. Focuses on the social, political, economic, and historical milieu in which black film emerged and evolved. Examines gender issues in filmmaking. Reviews different genres, including race films, colorblind representations, and black exploitation films, and the appropriation of black representation and black images in film in the United States and elsewhere. Includes methods of film analysis, such as historical, master narrative structure, and archival research. Pre: AFST 1714. (3H,3C)

### 3514: AMERICAN CINEMA GENRES

Close visual and cultural study of classic film genres with emphasis on cinematic styles and narrative conventions which unify the genre and which are found in representative films; exploration of genre films

as symbols of American culture and society. Specific thematic content is variable. Course may be repeated with different course content for up to 9 credits. Pre: TA 2054 or CINE 2054. (3H,3C)

#### 3524: THE CINEMA DIRECTOR

Close thematic and visual analysis of the films of prominent cinema directors; emphasis on cinematic structure and development and evolution of their work. Specific thematic content is variable. Course may be repeated with different course content for up to 9 credits. Pre: TA 2054 or CINE 2054. (3H,3C)

#### 3534: AVANT-GARDE CINEMA

Close visual and cultural study of the avant-garde and experimental tradition in the first half-century of American and European cinemas; emphasis on interrelations of cinema with avant-garde movements in other arts, including literature, music, dance, theatre, painting, and photography Pre: 2054. (3H,3C)

#### 3544 (ENGL 3544): LITERATURE AND CINEMA

Works of literature and the films into which they have been transformed; emphasis on differences between media. (3H,3C)

#### 4084 (COMM 4084): CINEMA HISTORY

Aesthetic, economic, social and technological history of world cinema; film theory as it relates to the history of cinema. Junior standing required. Variable credit course. Pre: TA 2054 or CINE 2054 or COMM 2054.

#### 4144: CINEMA STUDIES TOPICS

This course examines critical issues in the study of cinema, including issues of aesthetic and stylistic design, social and cultural context, historical development, and economic, industrial and technological factors in influencing the medium. Specific thematic content is variable. Course may be repeated with different course content for up to 9 credits. Pre: TA 2054 or CINE 2054. (3H,3C)

#### 4534: UNDERGROUND CINEMA AND CULTURE

Close visual and cultural study of underground cinema and culture from the 1940s through the 1970s; emphasizes the interrelations of cinema with countercultural movements in other arts, including literature, music, dance, theatre, painting, and photography; focuses on the post-war avant-garde, the emergence of film societies, the neorealist and new wave cinemas, challenges to censorship laws, and the emergence of cult and "midnight movies." Pre: 2054. (3H,3C)

## Undergraduate Course Descriptions (FA)

#### 2004: CREATIVITY & AESTHETIC EXPERIENCE

Guided exposure to participation in various experiences in the visual and performing arts; interaction with both historians/critics and practitioners prior to and after such experiences; examination of the many processes through which the visual and performing arts are created and communicated and how these arts illuminate and help to explain human experience. May not be repeated for credit. Pass/Fail only. (1H,1C)

## Undergraduate Course Descriptions (TA)

#### 1004 (MUS 1004): SCHOOL OF PERFORMING ARTS FIRST YEAR EXPERIENCE

Orientation to the School of Performing Arts philosophy and the resources of the School, the College, and the University. Cultivate a common intellectual, analytical, and creative conversation among first-year students. Enhance student participation in the creative and scholarly life of the School's programs. Foster a sense of community and understanding across disciplines. (1H,1L,1C)

#### 2014: INTRODUCTION TO THEATRE

Appreciation and understanding of theatre through historical perspectives, comparison with other art forms, and primary acquaintance with practice and techniques of script interpretation, producing, directing, acting, and all aspects of design. (3H,3C)

#### 2024: INTRODUCTION TO ACTING

The course is designed to lead the non major to an awareness and appreciation of acting, both as a participant (actor) and as an observer (audience). Emphasis is placed on improvisation, ensemble, and scene work. (3H,3C)

#### 2104: FUNDAMENTALS OF THEATRE AND PRODUCTION

Introduction to theatre vocabulary and understanding of the theatrical process, theatre aesthetics, theatrical modes of expression, basic script analysis, production analysis, theory and practice of collaboration, theatre organizations, history and operations of professional theatres. (T & C majors and minors only). (3H,3C)

#### 2114: SCRIPT ANALYSIS

Understanding of drama as an element of theatre with focus on the process of script analysis for theatrical production. (3H,3C)

#### 2134: ACTING LAB

An introduction to the process of acting, through a variety of laboratory experiences, beginning with basic performance skills and culminating in the performance experience. Emphasis is on improvisation, terminology, physical action, script analysis, characterization, and rehearsal and performance techniques. Limited to Theatre & Cinema Majors. (6L,3C)

#### 2135,2136: THEATRE DESIGN LAB

An introduction to the processes, technologies, and aesthetics of the visual design of theatrical productions. 2135: Scenography, costume, and stage lighting design are explored in history and contemporary theatre practice. 2136: A range of design problems will offer opportunity to learn various design approaches and provide practice with different media and means of design expression. (6L,3C)

#### 2144: FOUNDATIONS OF MOVEMENT AND VOICE

An introduction to the process of acting, through a variety of laboratory experiences, beginning with basic performance skills and culminating in the performance experience. Emphasis is on various methods of performance style and analysis, theater movement and body conditioning, and vocal awareness and production. Limited to Theatre & Cinema Majors. Pre: 2134. (6L,3C)

#### 2204: CREATIVE DANCE

Study of the expressive elements of movement and dance and practice designing learning experiences for K-12 students. (3H,3C)

#### 2224: INTERMEDIATE PERFORMANCE INTENSIVE

This course provides the Theatre & Cinema major, who desires a rigorous exploration of acting, a forum for application of the techniques and skills learned. These skills will be strengthened and applied through observation of and participation in scene and monologue work. Focus will be placed on basic skills and concepts necessary to creative, truthful, and believable performance of selected scenes, including use of voice and body, imagination, relaxation, sense and emotion memory, and script analysis. Limited to Theatre & Cinema Majors. Pre: (2134 or 2024), 2144. (3H,3C)

#### 2414: STAGE AND LIGHTING TECHNOLOGY

A practical study of the technologies and specialized equipment employed in the construction, rigging and running of theatrical production; the planning and organization involved in mounting these productions; the tools, materials and techniques used to realize theatrical design and build scenery; and the fundamentals of stage lighting. (3H,3C)

#### 2604 (MUS 2604): INTRODUCTION TO ARTS MARKETING

An introduction to the theories and practice of marketing and building community engagement as applied to arts activities and professional not-for-profit arts organizations, through a survey of standard marketing approaches, examination of current practices in the field, and direct hands-on experience. (3H,3C)

#### 2964: FIELD STUDY

Variable credit course.

#### 2974: INDEPENDENT STUDY

Variable credit course.

#### 2974H: INDEPENDENT STUDY

Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3014: THEATRE PRODUCTION LAB

Production experiences in the areas of performance, design and theatre technology, management, and writing. May be repeated for a maximum of nine credits. Instructor consent required. Variable credit course. X-grade allowed.

#### 3024: INTERMEDIATE ACTING FOR NON-THEATRE MAJOR

Performance class in acting skills, theories, and genres. Designed for non-theatre arts majors. Builds on fundamentals and theory learned in Introduction to Acting. Includes body and voice awareness, performance of specific genres, and expanded acting theory and analysis. Pre: 2024. (3H,3C)

#### 3105,3106: HISTORY OF DRAMA AND THEATRE

History of drama and theatre from primitive ritual to the present day and its relationship to the social, economic, and political forces from age to age. 3105: primitive, Greek, Roman, Medieval, Renaissance, and Asian. 3106: Restoration, eighteenth, nineteenth, and twentieth centuries. Junior standing required. Pre: 2114. (3H,3C)

#### 3114: SCENOGRAPHY TOPICS

Rotating topics in scenography and related specific design applications. Designed for theatre arts majors who have foundational training in areas of theatre design. May be repeated for credit. (Variable credit) Variable credit course. Pre: 2136.

#### 3124: COSTUME DESIGN AND TECHNOLOGY TOPICS

Rotating topics of costume design and costume technology. Designed for advanced theatre arts majors who have foundational training in all areas of theatre design. May be repeated for credit. (Variable credit) Variable credit course. Pre: 2136.

#### 3134: LIGHTING TOPICS

Rotating topics in lighting design and technology. Designed for advanced theatre arts majors who have foundational training in all areas of theatre arts. May be repeated for credit. (Variable credit) Variable credit course. Pre: 2136, 2414.

#### 3144: THEATRE DESIGN TOPICS

Rotating topics in design and theatre technology. Designed for advanced theatre arts majors who have foundational training in all areas of theatre technology and design. May be repeated for unlimited number of credit hours. (Variable credit) Variable credit course. Pre: 2414, 2136.

#### 3154: ACTING TOPICS

Rotating topics in performance skills and theories. Designed For advanced theatre arts majors who have foundational training in acting, voice and movement. May be repeated for credit. (Variable credit) Variable credit course. Pre: 2224, 2144.

#### 3164: VOICE AND SPEECH TOPICS

Rotating topics in voice and speech skills, and theories and practice in performance. Designed for advanced theatre arts majors who have foundational training in acting, voice and movement. May be repeated for credit. (Variable credit) Variable credit course. Pre: 2224, 2144.

#### 3174: MOVEMENT TOPICS

Rotating topics in theatre movement, dance for the theatre and theories of physical expression in the performing arts. Designed for advanced theatre arts majors who have foundational training in acting voice and movement. May be repeated for credit. (Variable credit) Variable credit course. Pre: 2144, 2224.

#### 3315-3316 (ENGL 3315-3316): PLAYWRITING

A workshop course in the craft and art of playwriting which emphasizes the development of craft and the nurturing of vision and art. 3315: primary focus is on the writing of original scripts with additional attention paid to the work of influential playwrights and critics. 3316: primary focus is on the creative process of developing a play with the collaborative influences of a director, actors, designers, and other theatre professionals. Consent of instructor required. Pre: ENGL 1106 or ENGL 1204H or COMM 1016 for 3315; 3315 for 3316. (3H,3C)

#### 3604: ARTS MANAGEMENT

The development of the not-for-profit arts organization, structures and characteristics of boards of directors, artistic missions and goals, funding, volunteer support, and fiscal control. Junior standing required. (3H,3C)

#### 3624: STAGE MANAGEMENT

The systems, procedures, forms, and duties of the stage manager in the professional, academic, and community theatre are explored in relationship to the production process and other theatre artists. Pre: 2104. (3H,3C)

#### 3954: STUDY ABROAD

Variable credit course.

#### 4014: CONTEMPORARY THEATRE SEMINAR

Issues and concerns in contemporary theatre; production philosophies and approaches, employment opportunities, career options, and preparation of portfolio and resume materials. Junior standing required. (3H,3C)

#### 4304: THEATRE OUTREACH

Participation in theatre projects or activities that focus on community and social issues. May be repeated for a maximum of six credits. Junior standing and instructor consent required. Variable credit course.

#### 4315-4316: DIRECTING

Script analysis, theories, techniques, and practical applications of theatrical direction. 4315: Theories and aesthetics of directing, functions of the director, script analysis, basic principles and techniques of staging. 4316: Rehearsal techniques, style determination realism, and non-realism. Senior standing required. (3H,3C)

#### 4704: PROFESSIONAL THEATRE INTERNSHIP

Internship of one semester in acting, directing, management, design, or technical theatre or cinema with a professional equity company for selected advanced students; classroom, workshop, and production experiences. Minimum 9 credits, maximum 15 credits. Audition and consent. Variable credit course.

#### 4964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 4974: INDEPENDENT STUDY

Variable credit course.

#### 4974H: INDEPENDENT STUDY

Variable credit course.

#### 4984: SPECIAL STUDY

Variable credit course.

#### 4994: UNDERGRADUATE RESEARCH

Variable credit course.

#### 4994H: UNDERGRADUATE RESEARCH

Variable credit course.



# 2016-2017 Undergraduate Course Catalog and Academic Policies

## Urban Affairs and Planning

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### Overview

[B.A. in Public and Urban Affairs](#)

[B.S. in Environmental Policy and Planning](#)

[Degree Requirements](#)

[Satisfactory Progress](#)

[Undergraduate Course Descriptions \(UAP\)](#)

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**Co-Chair:** Tom Sanchez

**University Distinguished Professor:** P. Knox

**Professors:** J.O. Browder, S. Hirt, T. Sanchez, and M. Stephenson

**Associate Professors:** D. Bieri, R. Buehler, R. Hall, K. Wernstedt, D. Zahm, and Y. Zhang

**Assistant Professors:** M. Cowell, S. Misra, T. Schenk, and T. Skuzinski

**Adjunct Professors:** B. Anderson, S. Mastran, E. Morton, J. Provo, and M. E. Ridenour

Web: [www.uap.vt.edu](http://www.uap.vt.edu)

## Overview

The Urban Affairs and Planning Program (UAP) offers two undergraduate degrees, the B.A. in public and urban affairs and the B.S. in environmental policy and planning, as well as minors under both degrees. At the graduate level the department offers the master of urban and regional planning degree.

## B.A. in Public and Urban Affairs

The B.A. in public and urban affairs (PUA) is an interdisciplinary social science degree with a professional cast. It aims to educate students in the liberal arts tradition while equipping them with the skills,



knowledge, and analytical thinking used in planning and policy. Students learn to address the political, economic, environmental, social, and governmental consequences of growth and change and to help resolve the problems that emanate from them.

## B.S. in Environmental Policy and Planning

The B.S. in environmental policy and planning (EPP) provides students the opportunity to study environmental problems and their solutions from an interdisciplinary perspective involving humanities, natural and social science, planning, and public policy. While rooted in scientific and technological fields, environmental problems and their solutions increasingly deal with public values, economics, law, policy, and planning. The EPP curriculum, while providing a broad liberal arts and natural and social science base, has a pre-professional slant involving analytical and communication skills and policy and planning methods to prepare students for employment and graduate study.

## Degree Requirements

The graduation requirements in effect at the time of graduation apply. When choosing the degree requirements information, always choose the year of your expected date of graduation. Requirements for graduation are referred to via university publications as "Checksheets". The number of credit hours required for degree completion varies among curricula. Students must satisfactorily complete all requirements and university obligations for degree completion.

The university reserves the right to modify requirements in a degree program. However, the university will not alter degree requirements less than two years from the expected graduation year unless there is a transition plan for students already in the degree program.

Please visit the University Registrar website at

<http://www.registrar.vt.edu/graduation/checksheets/index.html> for degree requirements.

## Satisfactory Progress

University policy requires that students who are making satisfactory progress toward a degree meet minimum criteria toward the General Education (Curriculum for Liberal Education) (see "[Academics](#)") and toward the degree in Urban Affairs and Planning.

Satisfactory progress requirements toward the B.A. in Public and Urban Affairs and B.S. in Environmental Policy and Planning can be found on the major checksheet by visiting the University Registrar website at <http://www.registrar.vt.edu/graduation/checksheets/index.html>.

## Undergraduate Course Descriptions (UAP)

### 1004: INTRODUCTION TO CAREERS IN URBAN AFFAIRS AND PLANNING

Introduces academic requirements for the Public and Urban Affairs (PUA) and Environmental Policy and Planning (EPP) majors. Assists students with academic planning and career exploration. Students develop an ePortfolio to document their personal and professional growth in the major. Course must be taken during the first semester in the PUA or EPP program. (1H,1C)

### 1024: PUBLIC ISSUES IN AN URBAN SOCIETY

This class introduces some of the most vital concerns and issues challenging democratic capitalistic urban societies today. Topics addressed include different perspectives on the causes and portent of the urban underclass, the growing inequality between the educated and less well educated in the nation's labor markets, the causes of the marked resegregation of many of the nation's urban centers by race and income and the implications of privatization and interjurisdictional competition for the public policy behavior and outcomes of subnational governments. (3H,3C)

### 2004 (REAL 2004): PRINCIPLES OF REAL ESTATE

Introduction to real estate, including markets, land use planning and zoning, development, finance, construction, sales, marketing, management and property valuation. Examines the key actors and processes in each of these areas. Explores major public policies impacting real estate. (3H,3C)

#### 2014: URBANIZATION AND DEVELOPMENT

Relationships between urbanization and economic development; role of cities in social, political, cultural, and economic development of societies; cities as settings for innovation and change. (3H,3C)

#### 2964: FIELD STUDY

Pass/Fail only. Variable credit course.

#### 2984: SPECIAL STUDY

Variable credit course.

#### 3014: URBAN POLICY AND PLANNING

An introduction to urban policy and urban planning. Includes analysis of the basic concepts and principles of urban policy, a review of urban policy in the United States, discussion of the development of urban planning and its role in shaping the urban environment, and an analysis of the relationship between public policy and planning and the organization and structure of the urban environment. Must complete prerequisite UAP 1024 with a B- grade or higher. Pre: 1024. (3H,3C)

#### 3024: URBAN AND REGIONAL ANALYSIS

Overview and application of various methods used to study, represent, understand communities in their urban and regional context. Data collection and analysis; population, land use, transportation and economic forecasting; selecting and applying an appropriate method; designing and presenting a community study. Restricted to majors and minors only. (3H,3C)

#### 3224: POLICY IMPLEMENTATION

Systematic analysis of the field and practice of public policy implementation. Includes analysis of the structure and dynamics of the policy process as well as specific analytic approaches to understanding policy implementation. Includes analysis of intra-organizational, interorganizational and intergovernmental implementation processes. Must complete prerequisites UAP 3014 (B- or higher) or 3354, and UAP 3024 (B- or higher). Pre: 3024, (3014 or 3354). (3H,3C)

#### 3264: CONTEMPORARY URBAN ISSUES

Consideration of one particular issue of immediate importance to the contemporary urban environment. Topics emphasize major social or economic policy issues, and may change each year. Junior standing required. (3H,3C)

#### 3344 (PSCI 3344): GLOBAL ENVIRONMENTAL ISSUES: INTERDISCIPLINARY PERSPECTIVES

Critical examination of major global environmental problems (e.g., global warming, atmospheric ozone depletion, acid rain, tropical deforestation, toxic waste) with emphasis on their social, economic, political, ethical, and policy implications and solutions. Completion of Area 4 of University Core required. (3H,3C)

#### 3354: INTRODUCTION TO ENVIRONMENTAL POLICY AND PLANNING

Introduction to the interdisciplinary principles of environmental policy, planning, economics, and ethics to address pollution abatement, resources conservation, habitat protection, and environmental restoration. The course will focus on practical means of identifying environmental problems and creatively solving them. (3H,3C)

#### 3434 (PSCI 3414): PUBLIC ADMINISTRATION

The role and context of public administration in the contemporary United States, administrative organization and decision-making, public finance, human resources administration, and program implementation. Pre: PSCI 1014. (3H,3C)

#### 3444 (PSCI 3444): ADMINISTRATIVE LAW AND POLICY

The legal context of the exercise of discretion by public administrators in the United States. Adjudication and rule-making; access to administrative processes and information; legislative and judicial control of administration. Pre: PSCI 1014. (3H,3C)

3464 (AHRM 3464) (APS 3464) (GEOG 3464) (HD 3464) (HUM 3464) (SOC 3464): APPALACHIAN COMMUNITIES

The concept of community in Appalachia using an interdisciplinary approach and experiential learning. Interrelationships among geographically, culturally, and socially constituted communities, public policy, and human development. Pre: Junior standing. (3H,3C)

3714 (PSCI 3714): THE U. S. POLICY PROCESS

Description and analysis of the processes and institutions involved in the making and implementation of public policy in the United States, with a primary focus on domestic and economic policy. Empirical and normative models of the process of public policy making in the U.S. Pre: PSCI 1014. (3H,3C)

3744 (PSCI 3744): PUBLIC POLICY ANALYSIS

Methods and approaches used in the analysis and evaluation of public policy; strengths and limitations of various analytic tools; normative issues in the practice of policy analysis. Pre: PSCI 1014 or PSCI 1014H. (3H,3C)

3774 (PSCI 3774): MARXIAN POLITICAL ANALYSIS

Contemporary uses of Marxian concepts and theories to study the world economy, business structure, current social issues, modern ethical values, and alienation. Pre: PSCI 1014 or PSCI 1014H. (3H,3C)

3954: STUDY ABROAD

Variable credit course.

4184: COMMUNITY INVOLVEMENT

Issues, concepts, and techniques of citizen participation in community development. Institutional frameworks and their historical precedents. Exercises developing group communications skills, public meeting facilitation, and design of community involvement programs. Pre: Senior standing required. (3H,3C)

4214 (GEOG 4214) (WGS 4214): WOMEN, ENVIRONMENT AND DEVELOPMENT IN A GLOBAL PERSPECTIVE

Explores intersecting roles of gender, culture, and socio-economic status in people's use of nature, management of environmental resources, and experiences of environmental change. Examines debates on environmental and development initiatives, environmental ethics, and environmental social movements from feminist perspectives. Pre: Junior standing required. (3H,3C)

4264: ENVIRONMENTAL ETHICS AND POLICY

Issues in applied environmental ethics. Contributions of diverse religious and philosophical traditions to contemporary perspectives on the human-nature relationship. Examination of environmental policies from utilitarian economic, deep ecology, and ecofeminist perspectives. Junior, senior or graduate standing required. (3H,3C)

4344: LAW OF CRITICAL ENVIRONMENTAL AREAS

This course examines the legal principles and policy debates involved in the regulation and protection of critical environmental resources. Specific topics vary but will likely include wetlands law and policy, endangered species habitat, open space, forestland and farmland protection, coastal zone management, and floodplain regulation and policy. (3H,3C)

4354: INTERDISCIPLINARY ENVIRONMENTAL PROBLEM SOLVING STUDIO

Interdisciplinary, experiential problem solving studio focusing on specific environmental problems. Working in groups, students interact with local officials, consultants, developers, environmental groups to explore the processes of environmental management, regulation and mitigation, applying techniques and skills frequently used by environmental planners and policy-makers. Senior status required and 9 credit hours, 3000-level or above, in the Environmental Policy and Planning major or minor; Pre: 3354, 3224. (2H,5L,4C)

4364: SEMINAR IN ENVIRONMENTAL POLICY AND PLANNING

Critical examination of the social, political, economic, legal, scientific, and technological contexts

underlying processes of environmental change, problems, and solutions, as seen from various conceptual and disciplinary perspectives. Senior status required and 9 credit hours, 3000-level or above, in the Environmental Policy and Planning major or minor. Pre: 3354, 3224. (2H,2C)

#### 4374: LAND USE AND ENVIRONMENT: PLANNING AND POLICY

Environmental factors involved in land use planning and development, including topography, soils, geologic hazards, flooding and stormwater management, ecological features, and visual quality. Techniques used in conducting environmental land inventories and land suitability analyses. Policies and programs to protect environmental quality in land use planning and development. Pre: Junior standing. (3H,3C)

#### 4384: POLLUTION CONTROL PLANNING AND POLICY

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, solid and hazardous wastes, toxic substances, and noise. Implementation of pollution control legislation, policies, and programs at federal, state, and local levels. (3H,3C)

#### 4394: COMMUNITY RENEWABLE ENERGY SYSTEMS

Practical design fundamentals for small scale renewable energy systems: solar building heating and cooling; solar domestic hot water; wind, photovoltaic, and hydroelectric systems; alcohol, methane and other biomass conversion systems. Developing plans, programs, and policies to stimulate development of renewable systems. Pre: (MATH 1016 or MATH 1025). (3H,3C)

#### 4624 (PSCI 4624): THE WASHINGTON SEMESTER: SEMINAR IN AMERICAN POLITICS AND PUBLIC POLICY

This seminar is the integrative forum for the principal elements of the Washington Semester experience. The course explores both the role of political institutions in policy formation and implementation and the primary managerial and leadership challenges that arise for implementing organization managers in American democratic public policy-making. Pre: Junior standing or instructor consent and acceptance into the Washington Semester program. X-grade allowed. (3H,3C)

#### 4644 (PSCI 4644): THE WASHINGTON SEMESTER: POLITICS, POLICY AND ADMINISTRATION IN A DEMOCRACY

This course is part of the Washington Semester. Explores the relationship between the imperatives of democratic mobilization, policy choices and organizational choices through intensive study of the operating context of a selected public or nonprofit organization. Examines implications of policy-maker choices for implementing institution dynamics and challenges. Pre: Junior standing and acceptance into the Washington Semester program required. X-grade allowed. Pre: PSCI 3714. (3H,3C)

#### 4714: ECONOMICS AND FINANCING OF STATE AND LOCAL GOVERNMENTS

Examines the provision and financing of public goods and services in local governments. Analyzes associated policy issues. Reviews experience in Western Europe and developing countries, as well as in the United States. Must complete prerequisites UAP 3024 with B- grade or higher, and ECON 2005 and 2006 with C grade or higher. Pre: 3024, (ECON 2005 or ECON 2005H), (ECON 2006 or ECON 2006H). (3H,3C)

#### 4754: LEGAL FOUNDATIONS OF PLANNING

Examination of the legal context in which urban planning and public policy operate. Legal structure, role of law, powers of sovereign governments, constitutional limitations on government activities, and public-private conflict and their influence on planning and public policy are examined. Pre: Junior standing required. (3H,3C)

#### 4764 (GEOG 4764) (SOC 4764): INTERNATIONAL DEVELOPMENT POLICY AND PLANNING

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. Junior standing required. (3H,3C)

#### 4854: PLANNING OF THE URBAN INFRASTRUCTURE

Course examines the interdependences among the elements of the built environment of the city and those between the elements of the built environment and the policy/planning structure of the city. Considered are those elements associated with the primary urban activities (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: 3224. (3H,3C)

**4914: SEMINAR IN PUBLIC AND URBAN AFFAIRS**

This capstone seminar explores the central questions of the role of the citizen and the citizenry in democratic capitalistic urban societies as well as the nature of accountability in such regimes. Topics such as the processes by which representation occurs, alternate theories of democratic community and the relationship of the public, private and civil sectors in urban society are treated. Senior status in PUA required. PUA majors and minors must complete this course with a C grade or higher to graduate; otherwise course must be repeated. Pre: 3224, 4714, 4754. (3H,3C)

**4954: STUDY ABROAD**

Variable credit course.

**4964: FIELD STUDY**

Variable credit course. X-grade allowed.

**4964H: HONORS FIELD STUDY**

Variable credit course.

**4974: INDEPENDENT STUDY**

Variable credit course. X-grade allowed.

**4984: SPECIAL STUDY**

Variable credit course.

**4994: UNDERGRADUATE RESEARCH**

Variable credit course.